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BURLINGTON ORTHODONTIC
RESEARCH CENTRE

2805

Progress Report Series

No. 1

1952 to 1956

DENTAL LIBRARY
TORONTO

Division of Dental Research
Faculty of Dentistry
University of Toronto
November, 1956.

FOREWORD

The Burlington Orthodontic Research Center Study, when completed will constitute a full history of the treatment and prevention of incipient malocclusion for a generation of children through the ages three to twelve years in a typical Ontario community. The experience and information concerning the etiology, diagnosis and treatment of malocclusion in these children are expected to form a veritable text book on this subject for more general application. Somewhere close to seventy percent of the million and a quarter children in this Province have faulty occlusion. From the Public Health viewpoint it is clear that no practical resolution of this problem can be brought about alone by the few dozen orthodontic specialists that can be trained in the foreseeable future. Great improvement can only come when general dental practitioners have been taught to handle the simpler cases for which the early diagnosis and treatment is relatively straightforward. The Burlington Orthodontic Research Center is therefore paving the way to better occlusion and oral health.

Signed,

Roy G Ellis

Dean,
Faculty of Dentistry.

INTRODUCTION

The following information is given for the purpose of
providing a brief history of the treatment and
prevention of infectious diseases for a general audience.
The purpose of this book is to provide a general
understanding of the principles and practice of infectious
disease control. The information is presented in a
concise and readable form. The book is intended for
the general public and for students of medicine and
public health. The book is divided into two main
parts. The first part deals with the principles of
infectious disease control. The second part deals
with the practice of infectious disease control.
The first part is divided into three chapters. The
first chapter deals with the principles of infectious
disease control. The second chapter deals with the
principles of prevention of infectious diseases. The
third chapter deals with the principles of treatment
of infectious diseases. The second part is divided
into two chapters. The first chapter deals with the
practice of infectious disease control. The second
chapter deals with the practice of prevention of
infectious diseases. The book is written in a
clear and concise style. The information is
presented in a logical and systematic manner.
The book is a valuable source of information for
the general public and for students of medicine
and public health.

Signed,

Roy L. ...
Dean,
Faculty of Medicine.

ACKNOWLEDGEMENTS

Acknowledgement is made of Dr. Robert E. Moyers who as Head of the Orthodontic Department of the University of Toronto from 1950 to 1953 conceived this study and was the grantee until accepting a new post as Head of the Orthodontic Department at Ann Arbor, Michigan.

Grateful acknowledgement is given to Dr. A.F. Bull, Medical Officer of Health, and to the Halton County Health Unit Staff for assistance in many ways with the conduct of this project. We wish to mention Dr. J. Mather, the previous Medical Health Officer of Halton County.

Acknowledgement and thanks are also owing to Dr. W. Clark of Hamilton, and to the Burlington Lions Club for assistance in establishing the clinic at 136 Brant Street in Burlington.

The bulk of the financial support for this project has been received from the Provincial and Federal Governments under National Health Project 605-1-20.

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THE OBJECTIVES OF THE BURLINGTON ORTHODONTIC RESEARCH CENTER ARE:

1. To demonstrate the value of interceptive orthodontics, i.e. the use of conservative treatment methods at an early age before serious complications develop. This is being carried out by treating the orthodontic needs of a complete generation of children as they age from three to twelve years. The success of alternative methods as applied at various ages is being recorded and it is hoped that the recognition and treatment of the more straightforward cases may be eventually taught to the general practitioners as well as to Orthodontists.
2. To compile a reliable set of records on which to base intensive studies of normal growth and development and the variations that occur in malocclusion. The data being gathered includes dental casts, case histories, and cephalograms or cephalometric radiograms. It is our hope that the outcome of these longer range studies will be simpler and more accurate diagnosis, more efficient treatment methods, and a better understanding of the etiology of malocclusion.
3. To assess the role of inheritance in determining a number of clinically significant characteristics of cranial and facial growth. An illustration of the possibilities of this work is provided by one of the current study of the relation of the sequence of eruption to the original position of the tooth bud in the jaw.
4. Assessment of the role of the General Practitioner in the treatment of malocclusion. This study has been completed and has indicated that although there is great interest by general practitioners in treatment of malocclusion, the training presently received as undergraduates cannot permit the general practitioner to play a major role without intensive supervision and aid from a qualified orthodontist. It is

felt that the general dental practitioners could eventually make a very significant contribution to the treatment of incipient malocclusion if simpler phases of the diagnosis and treatment were clarified and thoroughly taught to undergraduates.

THE STAFF OF THE BURLINGTON ORTHODONTIC RESEARCH CENTER

FOR THE 1956/57 SESSION

Director	Dr. F. Popovich	3 days per week
Geneticist and Research Fellow	Dr. M. Hatton	2 days per week
Manager and Technician	Mrs. M. Holbrook	3 days per week
Dental Assistant and Stenographer	Mrs. K.L. Scarlett	Full Time
Orthodontist	Dr. Bruce Morrow	1 day per week
Orthodontist	Dr. M. Johnston	1 day per week
Orthodontist	Dr. R. Boyko	2 days per week
Pedodontist	Dr. N. Feasby	$\frac{1}{2}$ day per week
Pedodontist	Dr. L. Scott	$\frac{1}{2}$ day per week

.....

Statistician and Research Consultant, Dr. R.M. Grainger, [£]
Chairman of Orthodontic Department, University of Toronto,
and Dental Health Statistician, Ontario Department of Health.

Dr. G. Nikiforuk, Chairman, Division of Dental Research,
Faculty of Dentistry, University of Toronto.

PAST STAFF MEMBERS AND ASSOCIATES

- (a) Dr. H. Jenkins, Past Head of Orthodontic Department
- (b) Dr. J.B. MacDonald, Past Chairman of Research Division,
Faculty of Dentistry
- (c) Dr. Bruce Malloch, Orthodontist
- (d) Dr. Robert E. Moyers, Past Head of Orthodontic Department
- (e) Miss B.E. Quinn, Hygienist
- (f) Dr. G. Sayers, Orthodontist

£ This report was prepared by the Chairman of the Orthodontic Department and the Director of the Research Center with assistance from the various other staff members.

B U D G E T

<u>YEAR</u>	<u>ITEM</u>	<u>AMOUNT</u>
1952-1953	Personal Services	\$ 8,020.00
	Travel	910.00
	Equipment	3,455.00
	Supplies and Materials	925.00
	Rent, Utility Services	195.00
	Other	285.00
		<u>\$13,790.00</u>
1953-1954	Personal Services	\$12,500.00
	Travel	1,350.00
	Equipment	5,974.00
	Supplies and Materials	1,884.55
	Rent, Utility, Services	990.00
	C.D.A. Studentship	201.95
	Other	475.00
		<u>\$23,374.95</u>
1954-1955	Personal Services	12,460.00
	Travel	600.00
	Equipment	809.85
	Supplies & Materials	2,384.55
	Rent, Utility Service	1,700.00
	Other	500.00
		<u>\$18,454.40</u>
1955-1956	Personal Services	14,251.50
	Travel	540.00
	Equipment	362.00
	Supplies & Materials	4,071.50
	Rent, Utility, Services	2,225.00
	Other	462.00
		<u>\$21,912.00</u>
1956-1957	Salaries	15,815.00
	Travel	600.00
	Equipment	2,255.50
	Supplies	3,500.00
	Rent & Utilities	2,590.00
	Other	750.00
		<u>\$25,510.00</u>

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DESCRIPTION OF THE COMMUNITY UNDER STUDY AND ITS DENTAL HEALTH BACKGROUND

The Town of Burlington has a population of approximately 8,500 people and is situated on the north shore of Lake Ontario near its western end. It is surrounded by a good market gardening district and has a growing industrial city of Hamilton only nine miles distant.

Since 1947 when the Halton County health unit was formed, Burlington has shared the attention of a trained staff including a medical health officer, Public Health Nurses, a Public Health Veterinarian, Sanitary Inspectors, and for the school years 1949-50, and 1950-51 respectively, dental health directors Dr. B. O'Meara, and Dr. G. Clark. (The Dental Health Program which is of the educational type was discontinued for the years 1952 to 1956 because of lack of personnel, but was reinstated in 1956 when the services of a trained Dental Hygienist, Miss D. Cranswick were made available under the supervision of Dr. M. Jarrett who is also Dental Health Director for the County of Wellington.)

In the intervening years the town received some dental health direction by Dr. G. T. Mitton, Professor of Dental Public Health, University of Toronto, who demonstrated public health practice to senior dental students in the well-baby clinics.

No intensive studies have been made to date of the nutritional status of the residents of Burlington, although it may be assumed that since the establishment of the Health Unit there is fairly wide knowledge and application of Canada's Food Rules and of good Dental Hygiene Practice. There are no fluorides in the community water supply which is drawn from Lake Ontario.

The town was served at the beginning of the program by six dental practitioners but considerable additional dental care is obtained from dentists in the city of Hamilton. But because the Burlington dentists also serve

DESCRIPTION OF THE UNIVERSITY OF THE SOUTH PACIFIC

The town of Suva is the capital of the country and is situated on the north-west coast of the island. It is a beautiful city with a good harbor and a pleasant climate. The University of the South Pacific is situated in the heart of the city. It was founded in 1968 and is the largest university in the Pacific region. The university has a wide range of faculties and departments, including the Faculty of Arts, the Faculty of Science, the Faculty of Education, the Faculty of Health Sciences, and the Faculty of Law. It also has a number of research centers and institutes. The university is known for its high standards of education and its commitment to research and development. It has a long history of excellence and is a leading institution in the Pacific region. The university is a member of the Association of Pacific Universities and the Association of South Pacific Universities. It is also a member of the International Association of Universities. The university is a member of the Pacific Rim University Association. It is a member of the Asia-Pacific University Association. It is a member of the Association of American Universities. It is a member of the Association of European Universities. It is a member of the Association of African Universities. It is a member of the Association of Latin American Universities. It is a member of the Association of Arab Universities. It is a member of the Association of Islamic Universities. It is a member of the Association of Buddhist Universities. It is a member of the Association of Hindu Universities. It is a member of the Association of Jain Universities. It is a member of the Association of Sikh Universities. It is a member of the Association of Zoroastrian Universities. It is a member of the Association of Jewish Universities. It is a member of the Association of Christian Universities. It is a member of the Association of Muslim Universities. It is a member of the Association of Hindu Universities. It is a member of the Association of Jain Universities. It is a member of the Association of Sikh Universities. It is a member of the Association of Zoroastrian Universities. It is a member of the Association of Jewish Universities. It is a member of the Association of Christian Universities. It is a member of the Association of Muslim Universities.

residents of the surrounding county, the actual dental population ratio may be in the order of 1 to 2,500.

At the outset, much thought was given to using Oakville, a slightly larger town 15 miles distant and in the same Health Unit as a control population. This idea was abandoned because of the seemingly ethical impossibility of recording and diagnosing the malocclusion without advocating treatment.

SELECTION OF CHILDREN FOR STUDY IN BURLINGTON

The sample of children constituted between 85 to 90 percent of the children residing in the town of Burlington who fall into the various age groups shown in Table I. The children who were excluded from the study were those whose parents for one reason or another wished them to be excluded. It is felt that the number of refusals is very low and that the children included may be considered representative of those residing in this Ontario community. Much credit is due to the Staff, and Dr. M. Hatton particularly, who over the first two years, by public lectures, school talks, newspaper advertising, consulting the Birth Registry and health unit files, and door to door canvassing secured the names and persuaded the parents of the twelve hundred children represented in the study to let their children come to the clinic.

EXPERIMENTAL DESIGN OF THE STUDY

During the first two years of the project a complete set of records has been taken for children aged 3, 6, 8, 10 and 12 years. These records will serve as a control indicating the condition and treatment needs of children growing up while receiving about the usual amount of orthodontic care available to children in a suburban area.^f

^f In the survey of 1950-51 by Dr. G. Clark the Dental Health Unit Director, only 1 child out of approximately 1200 examined was reported to be wearing an orthodontic appliance. This low level of treatment service was typical of similar Ontario regions.

TABLE I

AGE AND SEX DISTRIBUTION OF CONTROL GROUP FOR
WHOM A COMPLETE SET OF RECORDS ARE ON FILE

Age at Nearest Birthday	Male	Female	Total
3	134	104	238
6	167	136	303
8	96	126	222
10	112	107	219
12	116	102	218
TOTAL	625	575	1200

TABLE II

AGE AND SEX DISTRIBUTION OF SERIAL GROUP FOR WHOM
ANNUAL RECORDS ARE BEING TAKEN

Sex	3 yrs.	4 yrs. [£]	5 yrs.	6 yrs.	7 yrs.	8 yrs.
Males	134	163	133	70	1	-
Females	104	140	111	67	1	-
Total	238	303	244	137	2	-

£ Four year olds were added to the initial 238 children begun as three year olds in order to ensure a larger sample for the serial study.

The diagnosis of these needs will be performed and tabulated for future progress reports of the study.

Annual records are being taken for the 320, serial group of children as near as possible to their birthdays as was done for the control records mentioned above. The fourth set of these serial records are now being obtained and it is planned to continue taking annual records until the children reach a minimum of twelve years of age. Each child's facial development and occlusal status is diagnosed annually at which time a prescription is made out for the treatment, which the malocclusion cases are to receive during the year to follow. The future reports will give the details regarding the types of treatment and the success of the treatment, as applied to abnormalities of specific ages.

The methods of diagnosis are being constantly refined as a result of the study itself, hence the tables on the incidence or prevalence of malocclusion, both for the serial groups and the controls may be subject to the continual revision as the study progresses.

AUTHORITY TO STUDY BURLINGTON RESEARCH DATA

The Burlington data are not permitted to be removed from the premises of the research center. At present strict control is kept on the use of the data which will eventually be available for study upon application to the Research Committee of the Dental Faculty of the University of Toronto. Until the data has been completely compiled and has been used for its primary purpose, requests to study the material will only be granted when it is clear that no additional work will be thrust on the clinical staff which is engaged in gathering the data and carrying out the treatment. In cases of similar studies priority will be granted to the members of the staff who have been instrumental in gathering the data.

In the future, it is expected that the data will be permanently stored on the premises of the Faculty of Dentistry, University of Toronto for use of all students in the field.

DESCRIPTION OF THE RECORDS BEING TAKEN

The records are taken as close as possible to the month of the child's birthday and consist of the following:

1. Case history - which is a four page medical and dental history; see figures 1, 2, 3 & 4. The information is collected by asking the same information of each mother.
2. A clinically based assessment of the child's facial growth and occlusion on a chart to be used as a future record of treatment; figure 5.
3. Six cephalometric radiograms employing the high kilovolt technique of Harvold and Cartwright[£]; these include:
 - (a) Lateral plate with mandible in rest position.
 - (b) Lateral plate with mandible in contact position.
 - (c) Lateral plate with mandible in open position.
 - (d) Right and left oblique radiographs.
 - (e) Anteroposterior head plate.
4. One wrist radiogram is taken to determine the carpal index, figure 11.
5. Impressions and wax bites for dental casts, see figure 12.
6. Where thought likely to be needed for diagnosis of a difficult case, periapical films are taken.
7. Height and weight is recorded.
8. Black and white front and lateral view photographs were taken for the treatment group from 1954 on.
9. For some individuals electromyographic records are available.

Desire future additions:

Speech Therapy Records, Dental Caries Records, Exact Nutritional Records

£ Cartwright, L. J., and Harvold, E., improved radiographic results in cephalometry through the use of high kilovoltage. J.O.D.A. 261-263, May 1954.

DESCRIPTION OF THE METHOD

The records are taken as close as possible to the mouth of the child.

During the course of the following:

1. Case history - which is a four page medical and dental history, see figures 1, 2, 3 & 4. The information is collected by asking the case for formation of each tooth.

2. A clinical record - measurement of the child's facial growth and occlusion on a chart to be used as a future record of treatment; figure 5.

3. Six radiographic pictures employing the high kilovolt technique of Harvold and Garvold; these include:

(a) Lateral plate with mandible in rest position.

(b) Lateral plate with mandible in contact position.

(c) Lateral plate with mandible in open position.

(d) Right and left oblique radiographs.

(e) Inferior-superior head plate.

4. The wrist radiograph is taken to determine the carpal index; figure 11.

5. Impressions and wax bites for dental casts; see figure 12.

6. These charts help to be needed for diagnosis of a difficult case.

7. Radiographic films are taken.

8. Height and weight are recorded.

9. Back and chest front and lateral view radiographs were taken for the treatment from 1951 on.

10. For each individual's electroencephalogram records are available.

Dental history (figure 13):

Speech therapy records, dental X-ray records, dental radiological records

11. Carlsberg, L. J., and Harvold, E., Improved radiographic results in cephalometry through the use of high kilovoltage. J.O.D.A. 30:1-303, May 1957.

Page 1.

INTERVIEW REPORT

Date:

Name of interviewee:

Address:

Occupation:

Subject of interview:

Remarks:

Signature:

Date:

Place:

Signature:

Interviewer's Name

Page 2.

PREVENTIVE ORTHODONTICS HISTORY CHARTHistory of Birth

Mother's age (at time of birth): ; Father's Age:

Order of birth:

Type of birth: Term ; Premature: ; Late: ; Caesarian:

Birth weight:

Type of labour: Normal: ; Precipitate: ; Prolonged:

Instruments:

At home: ; Midwife:

Hospital:

Drugs:

Anaesthesia:

Surgery: ; When:

Presentation: Head: ; Transverse: ; Breech: ; Footling:

Condition after birth: Normal: ; Blue: ; Resuscitation:

Convulsions: ; Jaundice:

Paralysis: ; Medicine dropper:

Methods of milk feeding: Breast: ; Bottle: ; Age of weaning:
(from bottle)

Additional notes regarding milk diet:

Figure 2: Second page of form for recording case history.

RESEARCH AND ANALYSIS UNIT

1. Name of Unit

2. Location and Date of Study

3. Object of Study

4. Type of Study: Qualitative, Quantitative, Mixed

5. Title of Study

6. Type of Report: Research Report, Literature Review

7. Author(s)

8. Date of Study

9. Method

10. Results

11. Conclusions

12. Summary

13. References

14. Appendixes

15. Glossary

16. Bibliography

17. Index

(from Table 1)

18. Additional notes and references

Page 3.

PREVENTIVE ORTHODONTICS HISTORY CHARTChildhood Diseases (date in each case if possible)

Measles: ; Whooping Cough: ; Vaccine:

Scarlet fever: ; Chicken pox:

Diphtheria: ; Toxoid: ; Mumps:

Smallpox: ; Vaccination:

Other Diseases (what and how severely)

Period of convalescence:

Diet to present time: 1st year

2nd year

3rd year

Notes relative to diet:

Use of teething ring or any sort of comforter:

Age:

Time used:

Sucking habits: Thumb: ; Finger: ; Which:

How long each day:

Type of Sucking:

Notes on sucking:

if reduced

when stopped

Figure 3: Third Page of Form for Recording Case History.

RESEARCH AND ANALYSIS

Historical information about a case is provided

Location	Where the crime took place	Time	When the crime took place
Victim	Person or persons who were harmed	Offense	Crime or crimes committed
Perpetrator	Person or persons who committed the crime	Motivation	Reason for committing the crime

Other information about the case

Period of investigation

Time to complete the case

Cost

Rate

Case file number

For the purpose of this report

Page 2

Investigation report

For the purpose of this report

For the purpose of this report

For the purpose of this report

For the purpose of this report

PREVENTIVE ORTHODONTICS HISTORY CHARTHeredity

Type of occlusion:

In mother:

In mother's family:

In father:

In father's family:

Sibs:

Notes:

Missing teeth (congenital):

Mother:

Mother's family:

Father:

Father's family:

Sibs:

Notes:

History of twinning in family (multiple births): Maternal

Paternal: ; Type of twins:

Racial origin of mother: ; of father:

Education of mother: ; of father:

Occupation of father:

Consanguinity:

Marked asymmetries:

GENERAL INFORMATION

Name

Type of specimen

Is it a

Is it a

Is it a

Is it a

Is it a

Name

Number of specimens

Name

Number of specimens

Name

Number of specimens

Name

Name

History of specimen in family (including previous history)

Is it a

Is it a

Is it a

Is it a

Is it a

Is it a

HOW THE CLINIC FUNCTIONS

The responsible body for the diagnosis, treatment prescription and treatment of children coming under treatment is the clinic staff meeting as a committee chaired by the project director. For the generation being treated an annual diagnosis of the occlusion and state of the growth and development is performed. At this time, cases under active treatment are reviewed for progress, and new cases needing care are prescribed for.

Dental caries treatment, and extractions where needed are performed by private dental practitioners outside the clinic at the expense of the children's parents. Orthodontic treatment is not undertaken until caries treatment is completed, and the parents have been quick to assume this responsibility. A small fee is charged the parents in the rare cases of lost appliances to defray the cost of refabrication.

Dental records, models, and cephalostats are taken and the orthodontic treatments are performed in the one chair clinic which is staffed five days a week for this purpose. Pouring and trimming of models, processing of radiographs, and fabrication of appliances is carried out by the technical staff on the premises in a small laboratory and darkroom. The work of preparing tracings, taking cephalometric measurements, and pursuing research work has been largely done in the spare time and afterhours. This is true also of the monthly evening staff meetings held to diagnose and plan treatment of cases.

As the work expands, there will need to be provision for the clerical handling of data and the production of reports. In recognition of the moral responsibility for the welfare of each child in the group studied, it needs to be stressed that nothing, even the output of the research findings will be allowed to encroach on the time needed to carry out the careful treatment of the children who come under active care. At the time of this first progress report 108 children are under active appliance therapy which might be expected to continue for from a few months to several years.

INITIAL TREATMENT METHODS

Although the whole purpose of the project is to clarify the diagnosis and treatment of incipient malocclusion and demonstrate its effectiveness it was necessary to have a starting point based on present knowledge. Thus the following very briefly outlines the general principles on which the staff agreed treatment prescription would be based at the outset of the project. The wisdom of these procedures will be judged on the outcome of the demonstration and necessary refinements and corrections will then be made available. For simplicity, treatment of specific defects is listed below although it is obvious various combinations of defects are met in practice.

NEUTROCLUSION CASES

1. Congenitally missing teeth. Treatment to depend on amount of remaining tooth tissue available. Where there is no tendency toward macrodontia or antero protrusion space maintainers may be used or the space closed.
2. Supernumerary teeth. Removal of supernumerary teeth to be accomplished as soon as possible. In cases of duplication of teeth, the best positioned and formed tooth will be retained.
3. Premature loss of teeth. Fixed or removable space maintainers to be used in case of loss of deciduous teeth excepting incisors. After loss of permanent teeth, space is to be preserved

in the anterior and posterior region except in cases of anterior protrusion, or perhaps selected cases exhibiting an obvious imbalance of tooth size over jaw development.

4. Prolonged retention of deciduous teeth. Where permanent successors are not present the deciduous teeth may be retained in some cases as space maintainers or part of the functioning dentition or if the permanent teeth are of sufficient size, etc., the deciduous teeth may be extracted and the consequent space permitted to close, or closure promoted orthodontically.
5. Malformed teeth. Depending on the degree of malformation, crowding, etc., anterior teeth with good root formation will be retained for future crowns to improve esthetics.
6. Tooth to arch size disharmony. In deciduous dentition cases of relative macrodontia of unerupted permanent teeth where no upper spacing is observable, all teeth are going to be present, and tooth size to arch length indices indicate there will be even more crowding in the mixed dentition stage, serial extraction will be used to intercept the crowding and protrusion. This procedure may involve removing deciduous laterals to facilitate eruption of permanent centrals, then deciduous cuspids for permanent laterals, and lastly deciduous first molars and if possible surgically at this time, first bicusps to allow permanent cuspids to erupt in a more ideal position; or alternately the procedure may be postponed until at least partial eruption of permanent lateral incisors has occurred to permit maximum lateral growth in anterior maxillae.

7. Abnormal Frenums. If after cuspids erupt the space is still present between the centrals, it will be closed by an appliance and the frenum excised. (It is understood that supernumerary teeth are not a complication).
8. Horizontal Overjet with Open Contacts. Assuming this condition is the result of a habit and that no anterior displacement of maxillary buccal segments has taken place, or there is no tendency toward angle Class II occlusion, the teeth will be drawn back by an appliance such as Hawley bite-plane, monoblock, or labial arch wire. If thumb sucking and tongue thrusting, etc. are still active an appeal will be made first to the child to overcome the habit by muscle exercises or instruction, e.g. calendar method.
9. Posterior Crossbite will be treated by various appliances; e.g. lingual arch, expansion plate, inclined planes. If mouth breathing or pillowing habits are present, the appliances will be retained until normal physiology is restored.
10. Anterior Crossbites will be treated by such appliances as lower inclined planes (deep overbite) or upper acrylic plates with finger springs (cases with little overbite).
11. Abnormal overbites will be treated with bite-planes, monoblocks or full band techniques.

12. Open bite Cases. It is recognized that open bites may be the consequence of (1) tongue habits such as infantile swallowing, or secondary tongue habits where space has been created first by a finger or thumb habit, (2) vertical growth discrepancies in the condylar or tuberosity region.

Treatment of the former will consist of control of faulty tongue habit through exercises, intra-oral shields and orthodontic closure of the space. Treatment of the latter growth imbalance cases will depend on results of analysis of individual cases.

Distocclusion Cases

- 13(a) Non-skeletal (i.e. mainly involving dental displacement e.g. habit cases, premature tooth loss, mandibular distal positioning). Treatment will be attempted with monoblocks and/or headgear, or with labio lingual techniques and intermaxillary elastics accompanying habit control.
- 13(b) Skeletal (i.e. growth disharmonies such as small mandibles and/or large maxillaes). Treatment will be by monoblocks and headgear with possible extractions.

Mesioclusion Cases^f

14. Use of chin cap or monoblock to hold back mandibular growth. If anterior crossbite is present see section 10.

^f It should be clear that defects listed under neutroclusion may occur as complications of distocclusion and mesioclusion. The project is expected to clarify treatment of combinations of defects.

THE CORRECTION OF MALOCCLUSION BY THE GENERAL PRACTITIONER:

In a survey of Burlington schools in 1950-51, only 1 child was receiving orthodontic care, whereas the level of malocclusion indicated at least three or four hundred needed treatment. Also, it was clearly established by the 1952 report on the Welland and District Dental Educational program^f that in contrast to dental caries treatment which increased greatly after parents were notified of their children's needs, there was no appreciable increase in treatment of malocclusion. This fact has since been confirmed in other educational program regions.

Thus, it was assumed that general practitioners, although willing to treat dental caries for children were either unwilling or unable to treat malocclusion in the mouths of the same children. For many years a diagnostic service had been available through the orthodontic department of the University of Toronto, whereby general practitioners could mail in models; radiographs and case histories for advice on how to treat their private patient. This service was only rarely used and was not entirely satisfactory because of the limitation of the data mailed in.

It was therefore proposed that instead of general practitioners mailing in data for written advice, a consultant orthodontist might be made directly available through the facilities of Local Dental Health Directors to advise resident dentists regarding the treatment of malocclusion cases. Such an advisory service, supported by government funds in aid of private practitioners was not considered to be an objectional way of promoting a much needed public health service, particularly in regions where no orthodontic specialists were available.

^f The Welland and District Dental Health Program, Canadian Journal of Public Health, October, 1952, Page 420.

The consultative orthodontic service was made available through this project with local arrangements for the bringing together of the general practitioners with the consultant under the auspices of the local Dental Health Director. In all 54 days were actually spent on the service up to August 1954. During this time, assistance was given to 49 private dentists in 5 Health units where 413 children were examined. Of these 302 went under treatment by the general practitioner and 124 were referred to specialists as unsuitable for treatment by general practitioners.

The consultative service was discontinued during the fall of 1954, partly because of difficulty in hiring an orthodontist who would carry out the field work and partly because of the extreme pressure of work at the Research Center in Burlington. While it is clear that there was a real increase in the amount of orthodontic care received by the children in the health units receiving the consultative aid to private dentists, there was considerable difficulty limiting the responsibility of the consultant and defining the types of cases a private practitioner might attempt even under supervision.

Thus it is concluded that although there is no objection to a consultative service, and while it has been shown to be one means of bringing orthodontic care to regions where no orthodontists are available, the more fundamental and long range means of increasing treatment of malocclusion is likely to be by teaching undergraduates so that they will be able to render some service without constant supervision. The great task of this Burlington Orthodontic Research Center is to clarify the diagnosis and treatment of simpler types of incipient malocclusion so that the necessary teaching may be eventually given in the University.

THE ROLE OF HEREDITY IN THE DEVELOPMENT OF THE FACIAL SKELETON

In order to treat problems of irregularities successfully, the orthodontist requires amongst other things, not only a knowledge of the correlations which should exist between certain features of the face and jaws in the normal face, but he must also be able to recognize certain characteristics of growth in the maturational process of this region, characteristics which could be of prognostic value. Moreover, basic to all treatment planning must be a knowledge of the role of inheritance in growth and development of the facial skeleton.

Like Whyte (1953), Klatsky and Fisher (1953), and others, Harvold (1954) stresses the necessity for having a clear understanding of the two factors, heredity and environment. He writes:

"The weakness of the theories which regard the form development of the facial skeleton mainly in the light of function is due to the fact that there is still a lack of knowledge concerning the extent of the relative genetic independence of the various parts of the facial skeleton. We do not know to what degree the various bones are independent of each other and to what degree they are independent of the functional influence of the musculature".

Because of the complex nature of the facial skeleton including the jaws and the teeth all of which are subject to changes as a result of growth and development, any investigation of the genetic factors involved becomes most intricate. Other investigators (Lundstrom 1948; Bachrach and Young 1927 and others) have concerned themselves with the part played by inheritance in governing such factors as tooth size and occlusion, but the Burlington project offers an unprecedented opportunity to investigate an entirely different aspect of growth and development. This consideration does not only draw upon records derived from a large group of children of the same age which will be examined annually for several years, but the sample also includes several twin pairs. (See Table I, P. 26). Furthermore, similar sets of records including complete sets of cephalograms are available for each child.

The availability of these serial cephalograms of related individuals provides, for the first time, an opportunity for estimating hereditability values for certain characteristics in the dento-facial skeleton.

As it was mentioned earlier, the information which the orthodontist requires, is that which gives him a clear picture of the roles of inheritance and environment in governing certain features of the skeleton which are important to treatment planning. A review of the long range studies to be undertaken for this purpose includes three main considerations.

Of first importance is the aetiology of irregularities. These defects may be divided into those which are the expression of an individual's genetically controlled growth potential and result in an inharmonious relation of the parts of the skeleton as opposed to those which are the result of exogenous factors superimposed upon the individual's hereditary potential. Inharmonious skeletal variation of the first type will receive major consideration by this investigator. For although the literature is extensive on this subject, little has been written on the characteristics associated with the early recognition of such defects and whether or not the early symptoms (characteristics recognizable at perhaps three years of age) are genetically controlled.

The same may be said to be true of analysis of profile: at present no truly objective method for a determination of type of profile exists. It does not seem rash to assert that genetic factors must play a prominent role in this feature of the facial skeleton, but here again early characteristics must be determined as growth proceeds and related individuals must be compared with those who are unrelated.

Finally, the third study of clinical value is one which is at present underway. This involves a determination of the relation between eruption and occlusion. Here again the literature includes many reports on investigations on this subject, indeed, the present writer, (Hatton 1952) was able to show that an association

exists between type of eruptive sequence and growth in width of the dental arches, and furthermore, that the time taken for a tooth to erupt is governed mainly by inherited factors (Hatton 1954). The Burlington study facilitates further observations of this very problem. It is now possible to consider positional changes of the teeth several years before they erupt or reach their occlusal position, consequently one is able to determine the significance of position at certain ages along with rates of eruption and to relate these to certain skeletal characteristics. Finally it is possible to compare positional changes of the teeth in pairs of related children of comparable ages.

The Burlington study now includes 31 pairs of twins and 65 pairs of sibships of two members for whom comparable age records will be available within the next six to twelve months. (See Table I appended.)

In summing up, it should be emphasized that the serial records of cephalograms included in the Burlington study provides a unique opportunity for investigations which hitherto have been impossible. Because the records are serial, and because the cephalograms are of excellent clarity, changes in growth and development may be accurately noted and characteristics related to certain features recorded. Furthermore, since the sample includes a number of twin and sib pairs, the role of genetic factors in governing these characteristics may be evaluated. The three main groups of characteristics to be considered include those associated with the aetiology of skeletal irregularities in the jaws; those connected with certain types of profiles, and finally those related to eruption and occlusion. Any light which it is possible to shed on the behaviour pattern of these characteristics in the growth and development of the individual along with that of the relative effects of heredity and environment in governing these characteristics is of clinical significance for it will surely prove of value to the practitioner.

TABLE I

A Table Showing the Distribution of the Two Types
Of Related Individuals in the Burlington Sample

AGE IN YEARS	NO. OF PAIRS		TYPE OF PAIRS					
	Total		2 Males		1 Male	1 Female	2 Females	
	Twins	Sibs	Twins	Sibs	Twins	Sibs	Twins	Sibs
3	4	-	2	-	-	-	2	-
4	4	8	2	6	-	2	2	-
5	2	2	1	1	-	1	1	-
6	7	49	4	9	2	34	1	6
8	7	2	1	1	3	1	3	-
10	2	3	1	1	1	2	-	-
12	5	1	4	-	1	1	-	-
TOTAL	31	65	15	18	7	41	9	6

B I B L I O G R A P H Y

TO GENETIC SECTION

Bachrach, F. H. and Young, H., 1927. A Comparison of the Degree of Resemblance in Dental Characters shown in Pairs of Identical and Fraternal Twins. Brit. Dent. Jour. 48.

Lundstrom, A., 1948. Tooth size and Occlusion in Twins, Baslo, Switzerland.

Total

Hatton, M. E. 1952. A Comparison of Clinical Eruption of the Deciduous Teeth in Man with Growth in Width of the Dental Arches. Ph.D. Thesis, University of Toronto.

Harvold, E., 1954. The Postnatal Morphogenesis of the Facial Skeleton in Cleft Palate. Anatomical Institute. University of Oslo.

Hatton, M.E., 1954. A Measure of the Effects of Heredity and Environment on the Eruption of the Deciduous Teeth. Journal Dent. Res. 34: 397.

TABLE 1
 OF RELATIONSHIP BETWEEN THE AGE OF THE FISH AND THE LENGTH OF THE FISH

AGE IN YEARS	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)
1	10	100	12	144	14	196
2	15	225	18	324	20	400
3	20	400	22	484	24	576
4	25	625	26	676	28	784
5	30	900	30	900	32	1024
6	35	1225	34	1156	36	1296
7	40	1600	38	1444	40	1600
8	45	2025	42	1764	44	1936
9	50	2500	46	2116	48	2304
10	55	3025	50	2500	52	2704
11	60	3600	54	2916	56	3136
12	65	4225	58	3364	60	3600
13	70	4900	62	3844	64	4096
14	75	5625	66	4356	68	4624
15	80	6400	70	4900	72	5184
16	85	7225	74	5476	76	5776
17	90	8100	78	6084	80	6400
18	95	9025	82	6724	84	7056
19	100	10000	86	7396	88	7744
20	105	11025	90	8100	92	8464
21	110	12100	94	8836	96	9216
22	115	13225	98	9604	100	10000
23	120	14400	102	10404	104	10816
24	125	15625	106	11236	108	11664
25	130	16900	110	12100	112	12544
26	135	18225	114	12996	116	13456
27	140	19600	118	13924	120	14400
28	145	21025	122	14884	124	15376
29	150	22500	126	15876	128	16384
30	155	24025	130	16900	132	17424
31	160	25600	134	17956	136	18496
32	165	27225	138	19044	140	19600
33	170	28900	142	20164	144	20736
34	175	30625	146	21316	148	21904
35	180	32400	150	22500	152	23096
36	185	34225	154	23716	156	24316
37	190	36100	158	24964	160	25560
38	195	38025	162	26244	164	26836
39	200	40000	166	27556	168	28144
40	205	42025	170	28900	172	29484
41	210	44100	174	30276	176	30856
42	215	46225	178	31684	180	32256
43	220	48400	182	33124	184	33684
44	225	50625	186	34596	188	35136
45	230	52900	190	36100	192	36616
46	235	55225	194	37636	196	38124
47	240	57600	198	39204	200	39660
48	245	60025	202	40804	204	41224
49	250	62500	206	42436	208	42816
50	255	65025	210	44100	212	44436
51	260	67600	214	45796	216	46080
52	265	70225	218	47524	220	47744
53	270	72900	222	49284	224	49424
54	275	75625	226	51076	228	51124
55	280	78400	230	52900	232	52844
56	285	81225	234	54756	236	54584
57	290	84100	238	56644	240	56344
58	295	87025	242	58564	244	58124
59	300	90000	246	60516	248	59924
60	305	93025	250	62500	252	61744
61	310	96100	254	64516	256	63584
62	315	99225	258	66564	260	65440
63	320	102400	262	68644	264	67312
64	325	105625	266	70756	268	69200
65	330	108900	270	72900	272	71104
66	335	112225	274	75076	276	73024
67	340	115600	278	77284	280	74960
68	345	119025	282	79524	284	76912
69	350	122500	286	81796	288	78880
70	355	126025	290	84100	292	80864
71	360	129600	294	86436	296	82864
72	365	133225	298	88804	300	84880
73	370	136900	302	91204	304	86912
74	375	140625	306	93636	308	88960
75	380	144400	310	96100	312	91024
76	385	148225	314	98596	316	93104
77	390	152100	318	101124	320	95200
78	395	156025	322	103684	324	97312
79	400	160000	326	106276	328	99440
80	405	164025	330	108900	332	101584
81	410	168100	334	111556	336	103744
82	415	172225	338	114244	340	105912
83	420	176400	342	116964	344	108096
84	425	180625	346	119716	348	110296
85	430	184900	350	122500	352	112512
86	435	189225	354	125316	356	114744
87	440	193600	358	128164	360	116992
88	445	198025	362	131044	364	119256
89	450	202500	366	133956	368	121536
90	455	207025	370	136900	372	123832
91	460	211600	374	139876	376	126144
92	465	216225	378	142884	380	128464
93	470	220900	382	145924	384	130792
94	475	225625	386	148996	388	133136
95	480	230400	390	152100	392	135496
96	485	235225	394	155236	396	137864
97	490	240100	398	158404	400	140240
98	495	245025	402	161604	404	142624
99	500	250000	406	164836	408	145016
100	505	255025	410	168100	412	147416
101	510	260100	414	171396	416	149824
102	515	265225	418	174724	420	152240
103	520	270400	422	178084	424	154664
104	525	275625	426	181476	428	157096
105	530	280900	430	184900	432	159536
106	535	286225	434	188356	436	161984
107	540	291600	438	191844	440	164440
108	545	297025	442	195364	444	166904
109	550	302500	446	198916	448	169376
110	555	308025	450	202500	452	171856
111	560	313600	454	206116	456	174344
112	565	319225	458	209764	460	176840
113	570	324900	462	213444	464	179344
114	575	330625	466	217156	468	181856
115	580	336400	470	220900	472	184376
116	585	342225	474	224676	476	186904
117	590	348100	478	228484	480	189440
118	595	354025	482	232324	484	191984
119	600	360000	486	236196	488	194536
120	605	366025	490	240100	492	197096
121	610	372100	494	244036	496	199664
122	615	378225	498	248004	500	202240
123	620	384400	502	252004	504	204824
124	625	390625	506	256036	508	207416
125	630	396900	510	260100	512	210016
126	635	403225	514	264196	516	212624
127	640	409600	518	268324	520	215240
128	645	416025	522	272484	524	217864
129	650	422500	526	276676	528	220496
130	655	429025	530	280900	532	223136
131	660	435600	534	285156	536	225784
132	665	442225	538	289444	540	228440
133	670	448900	542	293764	544	231096
134	675	455625	546	298116	548	233760
135	680	462400	550	302500	552	236432
136	685	469225	554	306916	556	239112
137	690	476100	558	311364	560	241792
138	695	483025	562	315844	564	244472
139	700	490000	566	320356	568	247160
140	705	497025	570	324900	572	249856
141	710	504100	574	329476	576	252560
142	715	511225	578	334084	580	255272
143	720	518400	582	338724	584	257992
144	725	525625	586	343396	588	260712
145	730	532900	590	348100	592	263440
146	735	540225	594	352836	596	266176
147	740	547600	598	357604	600	268912
148	745	555025	602	362404	604	271656
149	750	562500	606	367236	608	274400
150	755	570025	610	372100	612	277152
151	760	577600	614	376996	616	279912
152	765	585225	618	381924	620	282672
153	770	592900	622	386884	624	285440
154	775	600625	626	391876	628	288216
155	780	608400	630	396900	632	290992
156	785	616225	634	401956	636	293776
157	790	624100	638	407044	640	296560
158	795	632025	642	412164	644	299352
159	800	640000	646	417316	648	302152
160	805	648025	650	422500	652	304952
161	810	656100	654	427716	656	307760
162	815	664225	658	432964	660	310576
163	820	672400	662	438244	664	313392
164	825	680625	666	443556	668	316216
165	830	688900	670	448900	672	319040
166	835	697225	674	454276	676	321872
167	840	705600	678	459684	680	324712
168	845	714025	682	465124	684	327560
169	850	722500	686	470596	688	330416
170	855	731025	690	476100	692	333272
171	860	739600	694	481636	696	336136
172	865	748225	698	487204	700	339000
173	870	756900	702	492804	704	341872
174	875	765625	706	498436	708	344752
175	880	774400	710	504100	712	347632
176	885	783225	714	509796	716	350512
177	890	792100	718	515524	720	353400
178	895	801025	722	521284	724	356296
179	900	810000	726	527076	728	

FUTURE PLANS

1. Addition of a speech therapy study.
2. Addition of a nutritional study of the serial group.
3. After the completion of the orthodontic studies, it may be possible to relate these data to a continued study of periodontal disease. The predisposing influences of early environment, nutrition, occlusion and oral hygiene, to the development of various symptoms of periodontal disease should be able to be studied as never before.
4. An additional bi-product of the longitudinal study of the serial group will be a longitudinal study of dental caries increments in the children in relation to the data available from the annual case histories.

S U M M A R I E S

of STUDIES EMANATING FROM AND USING BURLINGTON DATA

STUDY NO.	TITLE
1	The incidence of sucking habits and to Relationship to Occlusion in three year old children (Dr. F. Popovich).
2	The reliability of cephalometric measurements from the oblique head plates. (Dr. M. Hatton)
3	Sex variation in cephalometric measurements (Dr. M. Hatton)
4.	Eruption Sequence and vertical height in jaw for first permanent molars. (Dr. M. Hatton)
5.	Vertical Height of the body of the mandible and the occlusal level of the teeth in individuals with cleft and non-cleft palates. (Dr. A. L. Posen).
6	A lateral cephalometric study of the dento-facial morphology of three year old children having normal occlusion and distocclusion. (Dr. R. Perry).
7	A study of the dento-facial morphology of a group of three year old children with Class II, Div. 1 Malocclusion (Dr. J. G. Mitchell).
8	An investigation of the natural occlusal planes for deciduous teeth and the variation of the individual occlusal planes from average estimates by age and sex. (Dr. T. E. Spracklin).
9	A study of the cephalometric reference planes used in recording anteroposterior denture base relationships (Dr. R. Landsberg).
10	The relationship of a weight/height index to the total number of erupted canine, first bicuspid, second bicuspid, and second molar teeth in a sample of 10 year old children. (Dr. R. Fisk)
11	An electromyographic study of the temporalis muscle (Dr. H. Latif).

EXHIBIT 11

STUDIES CONCERNING HEAD AND ORBITAL DEVELOPMENT

NO.	TITLE
1	The incidence of suturing sutures and its relationship to Craniofacial development (Dr. R. L. Harvey).
2	The relationship of cephalometric measurements from the cephalic head plates (Dr. R. L. Harvey).
3	The variation in cephalometric measurements (Dr. R. L. Harvey).
4	Vertical separation and vertical height in man for three parameters analysis (Dr. R. L. Harvey).
5	Vertical height of the body of the mandible and the cephalic level of the teeth in individuals with class I and non-class I malocclusion (Dr. R. L. Harvey).
6	A lateral cephalometric study of the dental-facial morphology of three years in children in a mixed malocclusion and distocclusion (Dr. R. L. Harvey).
7	A study of the dental-facial morphology of a group of three year old children with class II, III, I malocclusion (Dr. R. L. Harvey).
8	An investigation of the natural occlusal planes for deciduous teeth and the variation of the individual occlusal planes from average estimated by age and sex (Dr. R. L. Harvey).
9	A study of the cephalometric reference planes used in recording cephalometric features from cephalograms (Dr. R. L. Harvey).
10	The relationship of a weight/height index to the total number of erupted canines, first premolars, second premolars, and second molars from a sample of 10 year old children (Dr. R. L. Harvey).
11	An electroencephalographic study of the temporalis muscle (Dr. R. L. Harvey).

THE INCIDENCE OF SUCKING HABITS
and its
RELATIONSHIP TO OCCLUSION IN 3 YEAR OLD CHILDREN

Investigator: Dr. F. Popovich

A study was carried out on the case histories and dental casts of 931 children, ages 3, 6, 8, 10, and 12 years. The lateral cephalometric radiograms of the 221 - 3 year old children were analyzed to determine the prevalence of sucking habits and their relation to occlusion. From this, it was estimated that about 42% of all children at one time have sucking habits and the rate is still 7.22% at 12 years of age. Abnormal occlusion rates were significantly higher among the active sucking group for the age levels of 3, 6, 8, 10 years.

For the children with habits the Class I malocclusion cases take on a similar skeletal characteristic as the Class II malocclusions because in both cases dento-alveolar protrusion was present. The Class II case with no habits generally results from either a small mandible or a large maxilla. In contrast, the Class II group with habits clearly shows maxillary dento-alveolar protrusion with generally a normal sized mandible.

Significant factors associated with the prevalence of sucking habits among children were: occupation of father, method of feeding, number of children in family, earlier weaning time and the use of a comforter.

CONCLUSIONS: Presented before Canadian Society of Dentistry for Children in Toronto, May, 1955, and to Great Lakes Society of Orthodontists at Columbus, Ohio, November, 1955.

1. Active sucking habits are associated with an increase in the prevalence of malocclusion among children of the 3, 6, 8, 10 year age groups.
2. The Class I and Class II malocclusion with habits differ distinctly from the Class I and Class II with no habit at 3 years of age. The malocclusions among the habit groups are characterized by a maxillary dento-alveolar protrusion and generally normal mandibles.

3. After hunger is satisfied the apparent major factor is the need to satisfy the sucking urge and if this is answered, even with the comforter, the actual weaning time or the mode of feeding is of little consequence. The remaining related factors may be summed up directly or indirectly on family psychological grounds.

STUDY NO. 2

A Comparison of Tooth Size and Mesio-distal Distance between Cuspid and First Permanent Molar in the Lower Jaw of a Group of Girls and Boys aged three and six years.

Investigator: Margaret E. Hatton.

Sample: The sample included the first records from a random group of 120 children.

Method: By the use of oblique cephalograms, a total of 240 tracings (left and right sides for each child) were made. A tangent was then drawn to the inferior border of the mandible and by means of a Boley gauge the following bilateral measurements were made:

- (1) The mandibular first ~~permanent~~ permanent molar width
- (2) The mandibular permanent cuspid width
- (3) The distance between the most mesial point on that border of the permanent cuspid and the most distal point on that border of the first permanent molar, on the same side, a distance called the mesio-distal distance between these teeth and abbreviated to M-D distance C-M.

Conclusions: At three years there appears to be no sex difference for the three measurements; at six years boys tend to be larger than girls in (3) above. The difference in the width of the teeth is extremely small. In both sexes there tends to be an overall increase in all three measurements between three and six years of age.

STUDY NO. 3

A Test to Determine the Reliability of Measurements taken from Tracings of Oblique Cephalograms. (Interim Report)

Investigator: Margaret E. Hatton

Sample: The sample used for this analysis included the records of 15 three year old children taken at random from the files.

Study No. 3 (Cont'd)

Method: The method employed involved making two sets of tracings of duplicate oblique cephalograms of each child, that is a total of 60 tracings, 4 per child. A tangent was then drawn to the inferior border of the mandible on each side and the following bilateral measurements were made:

- (1) The perpendicular distance from the mid-point between the two highest points on the cusps of the first permanent molar to the mandibular border = molar height.
- (2) The perpendicular distance between the highest point on the cusp of the permanent cuspid to the mandibular border = cuspid height.
- (3) The mesio-distal distance between the most mesial point on that border of the permanent cuspid to the most distal point on that border of the first permanent molar = M-D distance C-M.

The test then proceeded as an analysis of variance between cephalograms, tracings, and children. An estimate of variance for cephalograms and tracings was derived by squaring the difference in measurements between the pairs of totals and dividing by the number of observations, (4). The total variance for children has thus far been based on a single set of observations for each child for each of the three measurements.

Results: Results show that the experimental error which is contributed by tracings and cephalograms when oblique radiograms are used is very small, whereas that between children is considerably larger. Increasing the number of tracings and cephalograms will not reduce the error appreciably, this is in contrast to the benefit of increasing the sample size.

Conclusions: It may therefore be concluded that the single determination carried out by this investigator in tracing and measuring certain points from oblique cephalograms is efficient, and furthermore, to appreciably reduce the experimental error which does exist, the number of children rather than the number of cephalograms taken and tracings made must be increased.

STUDY NO. 4

A Determination of Tooth Position and Eruptive
Rate of the Mandibular First Permanent Molar in
Relation to Arch Width and Arch Length Beginning
when the Child is Three Years of Age. (Interim Report)

Investigator: Margaret E. Hatten.

Sample: The sample includes records from 120 three year old children, 60 girls and 60 boys.

Method: Tracings are being made of each of a series of oblique cephalograms (left and right sides) for each child. A tangent is then drawn to the inferior border of the mandible and positional changes of the molars are derived from measurements expressed in a horizontal and vertical plane and include:

- (1) The perpendicular distance from the mid-point between the two highest points on the cusps of this tooth to the tangent at the inferior border of the mandible = molar height.
- (2) The distance between the most mesial point on that border of the cuspid and the most distal point on that border of the first permanent molar, on the same side, a distance called the mesio-distal distance between these teeth and abbreviated to M-D distance C-M.
- (3) The distance between the most anterior point on the jaw to the centre of the crown of the molar = anterior-posterior distance.

Related Measurements include:

- (4) Length of the mandible bearing this tooth
- (5) Greatest mesio-distal width of this tooth = tooth size.
- (6) Size of gonial angle of the mandible bearing this tooth.
- (7) The perpendicular distance between the two highest points on the cusps of the deciduous molar to the tangent at the inferior border = deciduous molar height. A measurement used only as an estimate until the eruption of the permanent molars.

Results:

- (a) Histograms and scatter diagrams have been completed for measurements (1) and (2) above for all 120 children at three years.
- (b) Of the sample of 120 children measurements from records for three serial visits have been accumulated for 35 cases for (1) and (7) above.

Conclusions:

- (a) Perhaps the most obvious characteristic of tooth position is the degree of laterality or sidedness which exists between homologous teeth. Results for measurements (1) and (2) above upon analysis indicate that the average difference between sides tends to be zero. And also that there is no tendency to marked right or left sidedness beyond random variation for children at three years of age.
- (b) The results from the serial measurements, (1) and (7) above, reveal that at three years the position which the first permanent molars occupy above the inferior border of the mandible varies widely amongst individuals. (See Table 17 in data files). The range for boys is 14.9 mm. to 20.4 mm. and for girls 15.1 mm. to 19.9 mm. Furthermore, if the final occlusal position of these teeth is considered to be the same as that which the deciduous second molars now occupy, (a measurement used only as an estimate), then it appears that the low starters, or those teeth lying below the average height seem to have a greater distance to travel and these teeth seem to be travelling more slowly than those which start above the average height which seem to travel more quickly.

In addition to the measurements used in this analysis all seven measurements have now been completed for 84 children with three and 36 children with two sets of serial records. Final conclusions will only be possible when all measurements are accumulated for the total sample for at least four serial records, which must include the eruption time of the molars.

Study No. 4 (Cont'd)

No one factor is more important to the value of this study than the measurement of the distance of the teeth above the inferior border of the mandible first, when they erupt, and secondly, at occlusion.

Summary: The basic aim of this study is to shed light on the process of eruption. Owing to the nature of the Burlington records an opportunity is available to investigate this process in terms of tooth position in relation to eruptive rate, clinical eruption, and finally occlusion expressed in arch width and arch length. Moreover, since the total Burlington sample includes 96 pairs of related individuals a determination of the role of inheritance in governing tooth position will also be attempted.

The clinical significance of this study lies in the fact that it is possible to show that tooth position at three years is an indication of the rate of eruption and time of eruption. Rates of eruption for various types of individuals (precocious, average and slow with regards to tooth position at three years) will be established, and the significance, if any, of changing rates will be determined. Finally if it is possible to correlate tooth position and eruptive rate with arch width and length, this would mean that from the time that the child is three years old a consideration of tooth position, which may or may not be governed by genetic factors, could reveal not only the time of eruption but also something of the nature of arch width and length.

STUDY NO. 5

Vertical Height of the Body of the Mandible
and the Occlusal Level of the Teeth in Indi-
viduals with Cleft and Non-Cleft Palates

Investigator: Dr. A. L. Posen

It has been observed that in unilateral cleft palate individuals some of the maxillary teeth on the side of the cleft are not in contact with those of the mandible, while the non-cleft palate side of the same patient has such

Study No. 5 (Cont'd)

an occlusal contact. Thus, the unaffected side of the mandible enjoys occlusal function whereas the cleft side does not.

The purpose of this study was to compare vertical mandibular body height and occlusal height of the teeth of the right and left side in 49 unilateral cleft, 24 bilateral cleft, and 31 non-cleft palate children in Burlington, Ontario.

Oblique cephalometric headplates were used which allowed a comparison to be made between the right and left side of the mandible. The body of the mandible was divided into three areas, anterior, middle and posterior, and these were measured and compared. Also studied were the occlusal height of the first permanent molar, first and second deciduous molars, first and second premolars deciduous and permanent canines. These were measured from the lower border of the mandible to the highest part of the tooth.

Findings:

1. In the unilateral cleft palate individuals, the anterior area of the mandible on the cleft side is significantly greater in height than the anterior area of the mandible on the non-cleft side.
2. The level of the teeth in the anterior area of the mandible, i.e., the first deciduous molar, first premolar and canines, is higher on the cleft side than on the non-cleft side.
3. True vertical symmetry was not found in any individual.
4. Lack of occlusal function of the teeth does not adversely affect the vertical development of the mandible provided there are teeth present.

an individual. These measurements were of the mandible taken at the same time.

The purpose of this study was to compare the vertical height and occlusal height of the teeth of the right and left sides in 100 children, 50 girls and 50 boys, aged 10 to 14 years, in the University of Chicago.

These children were selected from the University of Chicago and were divided into three groups, anterior, middle and posterior, and these were measured and compared. Also studied were the occlusal height of the teeth permanent and deciduous, first and second deciduous molars, first and second premolars and permanent canines. These were measured from the lower border of the mandible to the highest part of the teeth.

Findings:

1. In the unilateral class patients (individuals), the anterior teeth of the mandible on the right side is significantly greater in height than the anterior teeth of the mandible on the non-right side.
2. The level of the teeth in the anterior area of the mandible, i.e., the first deciduous molar, first premolar and canine, is higher on the right side than on the non-right side.
3. The vertical symmetry was not found in any individual.
4. Lack of occlusal function of the teeth does not adversely affect the vertical development of the mandible provided there are teeth present.

STUDY NO. 6

A Lateral cephalometric Study of the Dento-Facial
Morphology of three year old Children having Normal
Occlusion and Distocclusion (Without Habits)

Investigator: Dr. R. Perry.

This study was undertaken to investigate differences in cranio-facial morphology between two groups of three year old children. The control group having normal occlusion, was composed of 15 boys and 15 girls. The abnormal or malocclusion group of 15 boys and 6 girls had a distocclusion associated with no undesirable environmental influences, such as sucking habits.

The study was carried out with data derived from case histories, clinical examinations, models and cephalometric radiograms. The findings -

- (1) Indicated no significant differences between the cranio-facial skeletal pattern of normal males and females.
- (2) Significant differences from normal cranio-facial relations were found to be associated with distocclusion in the following factors among males and females.
 - a) Increased distance of gnathion and "b" point posteriorly from "a" plane.
 - b) Decreased condylar angle of the mandible.
 - c) Upper incisors tipped lingually.
 - d) In males only, the following significant differences occurred:
 - i) Decreased distance from condyle to pterygomaxillary fissure.
 - ii) Decreased angle between cranial base and mandibular planes.
 - e) In Females only, the following significant differences occurred:
 - i) Decrease in over all mandibular length.
 - ii) Decrease in inclination of upper incisors.
 - iii) Decrease in lower face height palatal plane to menton.

Investigation of the Effect of the
Hypophysectomy on the Development of the
Mammary Glands in the Rat

Investigator: Dr. R. R. Rupp

This study was undertaken to investigate differences in mammary gland development between two groups of three year old children. The control group having normal nutrition was composed of 15 boys and 15 girls. The experimental or malnourished group of 15 boys and 15 girls had a diet of 10% protein and 10% fat with no additional experimental treatment, such as feeding studies. The study was carried out with data derived from case histories, clinical examinations, roentgen and cytopathologic techniques. The findings are:

- (1) Indicated no significant differences between the mammary gland pattern of normal cases and malnourished.
- (2) Significant differences from normal mammary gland pattern were found to be associated with malnutrition in the following manner: a) Increased diameter of axilla and 10% fat posteriorly from 10% plane. b) Decreased axillary angle of the axilla. c) Upper incisors tipped 15 degrees. d) In cases only, the following significant differences occurred:
 - i) Increased diameter from weight to 10% malnourished plane.
 - ii) Decreased angle between axilla and the anterior plane.
- e) In female only, the following significant differences occurred:
 - i) Decrease in size of mammary gland.
 - ii) Decrease in incidence of upper incisors.
 - iii) Increase in size of breast pad and 10% fat plane.

STUDY NO. 7

A Study of the Dento-Facial Morphology of a
Group of 3 Year Old Children with Class II
Div. 1 (Angle) Malocclusion (with a Sucking
Habit)

Investigator: Dr. J. G. Mitchell

The purpose of this study was to determine if any significant differences exist between clinically excellent occlusions and Class II, Div. I (Angle) malocclusion in children with a sucking habit at 3 years of age.

Thirty children, fifteen male and fifteen female, with clinically excellent occlusion (normals) were used as a control group. The second group also consisted of 30 children, 15 male and 15 female, with Class II, Div. I (Angle) malocclusion, and a sucking habit.

Angular and linear measurements from tracings of lateral cephalograms, and measurements directly upon casts of their teeth, were compared in the groups of children studied.

The children with Class II, Div. I, malocclusions were found to differ from the control group in the following characteristics.

1. A longer maxilla
2. A greater distance between pterygomaxillary fissure and second deciduous molars.
3. Posterior positioning of the anterior portion of the mandible in relation to "A" plane.
4. Narrower maxillary dental arches in region of second deciduous molars and cuspids.
5. Narrower mandibular dental arches in the region of the second deciduous molars.

STUDY NO. 8

An Investigation of the Natural Occlusal Plane
For Deciduous Teeth and the Variation of the
Individual Occlusal Planes From Average Estimates
By Age and Sex

Investigator: Dr. T. E. Spracklin

Records for analysis were obtained from the files of the Burlington Orthodontic Research Centre for the purpose of computing estimated average occlusal planes for males and females with normal (Class I) tooth relations at ages three, six, eight and ten years. From tracings of lateral cephalograms the position of the occlusal plane on the deciduous teeth was expressed by three reference points which were located in a similar manner throughout the age groups studied. Least squares straight lines were fitted through the above points using a system of right angled coordinates having as the abscissa the bisector of the palatal occlusal angle and as the origin the perpendicular from orbitale. Variations in the position of the occlusal plane in vertical height and angulation were significant between the age groups. The unpredictable variation for individual children's occlusal planes from the estimated average occlusal planes, were found to be in the order of plus or minus three to five millimeters vertically and plus or minus five to seven degrees angularly.

The practical value for analysing the anteroposterior displacement of the denture or its components is discussed for the natural occlusal plane the estimated occlusal plane, and a plane at a constant angle to the cranial base.

Publication: Master of Science thesis, filed in Graduate Studies Department University of Toronto.

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STUDY NO. 9

A Study of Cephalometric Reference Planes Used
In Recording Anteroposterior Denture Base Re-
lationships

Investigator: Dr. R. Landsberg.

The problem of diagnosing prognathism has been studied in terms of fifty children eight years of age, having normal occlusions, whose dental casts and cephalograms were available from the Burlington Orthodontic Research Centre.

It was found impossible in terms of absolute measurements to mathematically predict within chance variation the position of the occlusal plane in a rectangular coordinate system based on the palatal and, or, mandibular planes. The range of error for the mean predicted occlusal planes as applied to individuals was vertically up to five millimetres and angularly about fourteen degrees. When an estimate of the cant of the occlusal plane is required as a reference plane to replace the natural occlusal plane in mutilated cases (where the teeth are missing) the simplest methods may be to draw a line about 12.5 degrees below the angle of the palatal plane or to use a plane at about 1.5 degrees above the bisector of the palatal mandibular planes.

Significant agreement of the diagnosed basal prognathism as derived from reference to the natural occlusal plane, the bisector plane, and the plane forty degrees to the cranial base was shown by Spearman's rank correlation coefficient, .645 and .539 respectively. No significant correlation was found in the diagnosis of basal prognathism based on the natural occlusal reference plane and the SNa, SNb angular system of Reidel.

Publication, Master of Science Thesis filed in Graduate Studies Department of University of Toronto.

STUDY NO. 10

The Relationship of a Weight/Height Index To
The Total Number of Erupted Canine, First Bi-
Cuspid, Second Bicuspids and second Molar Teeth
In a Sample of 10 Year Old Children

Investigator: Dr. Ross Fisk.

INTRODUCTION

A knowledge of dental development is of particular interest and value to the orthodontist. Probably many factors are associated with tooth eruption. A determination of common factors associated with tooth eruption would have special significance in orthodontic diagnosis.

PURPOSE

To determine from available data if tooth number progresses with some specifiable relationship with bodily development.

METHOD

For a sample of 10 year old children a record of individual erupted
7654321 1234567 teeth will be obtained from dental casts. Each subject's
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weight in pounds will be divided by height in inches to obtain an expression of physical development in a term of size and proportion. Statistical tests will be used to relate the weight/height indices to the total number of erupted maxillary and mandibular teeth.

SPECIFIC QUESTIONS TO BE ANSWERED:

- (1) The significance of any relationship.
- (2) Does the mandibular denture have a closer statistical relationship than the maxillary denture.
- (3) What is the percentage of total variation in tooth number at the 10 year age level that may be associated with the factors of physical size and proportion.

STUDY NO. 11

An Electromyographic Study of the Temporalis
Muscle

Investigator: H. Latif.

This study was carried out at the Orthodontic Research Centre, Burlington, from November 25th, 1955 to January 7th, 1956, using children aged 10 - 14 years with normal dentofacial structure as subjects. The selection of the subjects was based on the unpublished work of Dr. F. Popovich, the Director of the Centre. The object of the research was to investigate:

1. The method of surface electromyography that compares favourably with needle electromyography.
2. The action of the temporalis muscle in various movements and positions of the mandible.
3. Whether the resting tone is present in all the parts of the muscle, and, if so, whether it was uniformly distributed.

A four channel electroencephalograph model III brought from the orthodontic department, University of Toronto was used.

The total number of the subjects studied was 25. The findings are as follows:

1. Temporalis muscle maintains the mandibular posture, in physiological rising position, the posterior fibres taking more part than the anterior.
2. Temporalis is an ipsilateral and a contralateral elevator of the mandible.
3. During the maximal opening of the mouth, the temporalis muscle acts as an antagonist and prevents the dislocation of the mandibular joint.
4. Temporalis is a very active elevator of the mandible. All parts are maximally active during molar occlusion.
5. In "end to end" occlusion the anterior fibres of the muscle are more active.
6. The muscle does not play any part in mandibular protraction.
7. Resting tonus in the muscle is decreased during protraction in a considerable

Study No. 11 (Cont'd)

number of persons.

8. Temporalis retracts the protruded jaw.
9. Placing the reference electrode far away introduces extraneous electrical interference into the records giving wrong results.

Publication: Master of Science Thesis, on File in Graduate Department of University of Toronto.

DATA FILES

Over the years the data in the stacks has been used not only for the major purposes of the study but for various individual investigations by University Staff members, and by Graduate Students. It has seemed fair to ask all workers who have been granted use of the Burlington Stacks to donate any consolidations of basic measurements they may have produced to the Data files. The specific measurements will then not necessarily need to be repeated by individual future workers and thus will be readily available to all who may wish to use them, providing they give proper acknowledgment of their source. Hence the release of raw data as non-specific bi-products of the main project, and may indeed prove to be as valuable as the main study itself. It will be the eventual goal of the curators of these data when the active clinical stage is finished to consolidate all pertinent data in this form for world wide distribution.

Data will be identified as to the circumstances of their collection such as probable accuracy, definitions of the criteria, and details of sampling of any and the purposes or studies for which they have been used.

DATA FILE TABLE NO.1

POSITION OF DENTITION IN ALVEOLAR BONE BY TYPE OF OCCLUSION IN
3 YR. OLD CHILDREN

OCCLUSION	NO.	e/e TO A	e/e TO PTM	e/e TO B	OVERJET
NORMALS	109	22.8	23.1	21.7	2.3
CLASS I MAL (NO HABITS)	15	22.8	23.7	21.4	3.2 ^f
CLASS I MAL (WITH HABITS)	52	23.1	24.4 ^f	21.6	4.5 ^f
CLASS II (NO HABITS)	19	23.2	23.7 ^f	21.6	3.6 ^f
CLASS II (WITH HABITS)	26	23.2	24.4 ^f	22.1	5.3 ^f

Mean in mms.

Source: Popovich, Study No. 1

^f These values significantly different from normal occlusion types
 Significant difference (associated with presence of habit)
 ← S → with occlusion type.

DATA FILE TABLE 2

SIZE AND POSITION OF MANDIBLE AND MAXILLA BY TYPE OF OCCLUSION
IN 3 yr. OLD CHILDREN (means in mm.)

OCCLUSION	NO.	MANDIBLE LENGTH C/B	MAXILLA LENGTH A TO PTM	SELLA TO PTM	SELLA TO CONDYLE	A AHEAD OF B	
						IN REST	IN OCCLUSION
NORMALS	109	74.9	46.6	22.5	5.6	0.4	0.1
CLASS I MAL (NO HABITS)	15	74.3	46.7	22.3	4.9	0.3	0.5
CLASS I MAL (WITH HABITS)	52	75.8	47.9 [£]	22.5	5.5	0.1	0.4
CLASS II (NO HABITS)	19	72.7 [£]	47.7 [£]	22.4	5.9	2.4	2.9 [£]
CLASS II (WITH HABITS)	26	75.1	47.8 [£]	22.7	5.0	1.1	1.4 [£]

Source: Popovich, Study No. 1

£ These values significantly different from normal occlusion types

← S → Significant difference (associated with presence of habit) with occlusion type.

SECRET

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY

PLANT	HEIGHT	WIDTH	DEPTH	WEIGHT	VALUE	DATE	LOCATION
1.0	4.0	2.5	1.5	1.0	1.0	1910	ST. LOUIS
2.0	5.0	3.0	2.0	1.5	1.5	1911	ST. LOUIS
3.0	6.0	3.5	2.5	2.0	2.0	1912	ST. LOUIS
4.0	7.0	4.0	3.0	2.5	2.5	1913	ST. LOUIS
5.0	8.0	4.5	3.5	3.0	3.0	1914	ST. LOUIS
6.0	9.0	5.0	4.0	3.5	3.5	1915	ST. LOUIS

Lowest: 1.0, 4.0, 2.5, 1.5, 1.0, 1.0, 1910, ST. LOUIS

These values are calculated from the following data:

Significant differences (associated with the 5% level of probability) are indicated by the following symbols:

DATA FILE TABLE 3.

CALCULATED PERSISTENCE OF SUCKING HABIT BY AGE

AGE	NO. OF CHILDREN STUDIED	CALCULATED TO HAVE SUCKED (42%)	REPORTED ACTIVE	CALCULATED PERSISTENCE OUT OF THOSE SUCKING
3 yr	230	96.6	% 41.8	% 98.3
6	164	68.9	29.2	70.0
8	191	80.2	18.5	28.0
10	155	65.1	12.9	30.7
12	135	56.7	7.2	17.6

Source: Popovich, Study No. 1

DATA FILE TABLE 4.

REPORTED PERSISTENCE OF SUCKING HABIT BY AGE

AGE	NO. OF CHILDREN STUDIED	REPORTED TO HAVE SUCKED	REPORTED ACTIVE	REPORTED PERSISTING
3 yr	221	% 43.2	% 41.8	% 96.8
6	164	40.2	29.2	72.7
8	191	35.5	18.5	52.0
10	155	31.0	12.9	41.7
12	135	28.6	7.2	25.0

Source: Popovich, Study No. 1

TABLE 1. SUMMARY OF DATA FOR 1964

TABLE 1. SUMMARY OF DATA FOR 1964

STATION	DATE	TIME	WAVE	PERIOD
1	10/1	10:00	10.0	10.0
2	10/2	10:00	10.0	10.0
3	10/3	10:00	10.0	10.0
4	10/4	10:00	10.0	10.0
5	10/5	10:00	10.0	10.0

Continued on next page

TABLE 2. SUMMARY OF DATA FOR 1965

TABLE 2. SUMMARY OF DATA FOR 1965

STATION	DATE	TIME	WAVE	PERIOD
1	11/1	10:00	10.0	10.0
2	11/2	10:00	10.0	10.0
3	11/3	10:00	10.0	10.0
4	11/4	10:00	10.0	10.0
5	11/5	10:00	10.0	10.0

Continued on next page

DATA FILE TABLE 5

FREQUENCY AND ETIOLOGY OF MALOCCLUSION BY AGE
AS JUDGED FROM STUDY OF MODELS ONLY

(Preliminary not based on total sample finally obtained
and hence subject to revision)

AGE NEXT BIRTHDAY	NO. EX'D	% HAVING MALOCCLUSION #	% OF MALOCCLUSION CASES JUDGED CAUSED BY			% 's JUDGED TO BE			CL I Norml
			CARIES	HABITS	HEREDITY [£]	Class I	Class II	Class III	
3&4	281	45.9	2.0	73	25	23.5	22.4	0	54.1
6	104	34.5	17.1	54.3	28	16.3	17.3	.9	65.5
8	125	51.7	31.0	43.1	25	21.5	29.4	.8	48.3
10	92	54.2	28.2	22	40	22.7	30.4	1.1	45.8
12	87	71.1	32.6	26	41	35.6	33.3	2.2	28.9

Source: Popovich, Study No. 1

malocclusion described as models exhibiting overbite greater than 50% of crown, overjet greater than 3 mm., arch crowding by more than 1.0 mm. per quadrant, or cuspid molar relation other than Class I

£ malocclusion not attributable to any obvious environmental factor such as early loss of teeth, or habits.

DATA FILE TABLE NO. 6

RELATION OF MANDIBLE AND MAXILLA TO CRANIAL PLANE
IN 3 YR. OLD CHILDREN

OCCLUSION	NO.	BOLTON-NASION TO B MEAN IN DEGREES	BOLTON-NASION TO A MEAN IN DEGREES
NORMALS	109	59.6	64.6
CLASS I MAL (NO HABITS)	15	59.5	65.7
CLASS I MAL (WITH HABITS)	52	60.2	66.3 [£]
CLASS II (NO HABITS)	19	57.2 [£]	64.2
CLASS II (WITH HABITS)	26	59.7	66.1 [£]

£ These values significantly different from normal occlusion types

S Significant difference (associated with presence of habit) with occlusion type.

Source: Popovich Study No. 1

DATA FILE TABLE NO. 7

SIZE AND POSITION OF MANDIBLE AND MAXILLA BY TYPE OF OCCLUSION
IN 3 YR. OLD CHILDREN

OCCLUSION	No	MANDIBLE LENGTH C-B	MAXILLA LENGTH A TO PTM	SELLA TO PTM	SELLA TO CONDYLE	A AHEAD OF B	
						IN REST	IN OCCLUSION
NORMALS	109	74.9	46.6	22.5	5.6	0.4	0.1
CLASS I MAL (NO HABITS)	15	74.3	46.7	22.3	4.9	0.3	0.5
CLASS I MAL (WITH HABITS)	52	75.8	47.9 [£]	22.5	5.5	0.1	0.4
CLASS II (NO HABITS)	19	72.7 [£]	47.7 [£]	22.4	5.9	2.4	2.9 [£]
CLASS II (WITH HABITS)	26	75.1	47.8 [£]	22.7	5.0	1.1	1.4 [£]

Mean in Mms.

Source: Popovich, Study No. 1

£ These values significantly different from normal occlusion types.

→ Significant difference (associated with presence of habit) with occlusion type.

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TABLE 1. SUMMARY OF DATA

TABLE 1. SUMMARY OF DATA FOR THE STUDY OF THE EFFECT OF THE CONCENTRATION OF THE SOLUTION ON THE RATE OF REACTION

CONCENTRATION OF SOLUTION (%)	TIME (min)	TEMPERATURE (°C)	INITIAL RATE (mol/l·min)	AVERAGE RATE (mol/l·min)	FINAL RATE (mol/l·min)	REMARKS
0.1	10	25	0.001	0.001	0.001	
0.2	10	25	0.002	0.002	0.002	
0.4	10	25	0.004	0.004	0.004	
0.6	10	25	0.006	0.006	0.006	
0.8	10	25	0.008	0.008	0.008	
1.0	10	25	0.010	0.010	0.010	

These values represent the initial rate of reaction for each concentration of the solution. The average rate is calculated as the total change in concentration divided by the total time. The final rate is the rate at the end of the reaction.

DATA FILE TABLE NO. 8

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Same as #1

POSITION OF DENTITION IN ALVEOLAR BONE BY TYPE OF OCCLUSION
IN 3 YR. OLD CHILDREN

OCCLUSION	NO.	<u>e/e</u> TO A	<u>e/e</u> to PTM	<u>e/e</u> TO B	OVERJET
NORMALS	109	22.8	23.1	21.7	2.3
CLASS I MAL (NO HABITS)	15	22.8	23.7	21.4	3.2 [£]
CLASS I MAL (WITH HABITS)	52	23.1	24.4 [£]	21.6	4.5 [£]
CLASS II (NO HABITS)	19	23.2	23.7 [£]	21.6	3.6 [£]
CLASS II (WITH HABITS)	26	23.2	24.4 [£]	22.1	5.3 [£]

Mean in mms.

Source: Popovich, Study No. 1

£ These values significantly different from normal occlusion types
 _____ Significant difference (associated with presence of habit)
 S with occlusion type.

DATA FILE TABLE NO. 9

RATES OF SUCKING HABITS IN RELATION TO
FATHER'S OCCUPATION

OCCUPATIONS	EXECUTIVE AND PROFESSIONAL	NON-SKILLED LABOURER SALESMAN	SKILLED LABOURER WHITE COLLAR SELF EMPLOYED	FARMER
SAMPLE (n) 279	55	49	157	18
RATE OF SUCKERS	55%	45%	38%	28%

Above Rates not significant but bordering on 5% limits.

Source: Popovich, Study No. 1

DATE FILE TABLE NO. 10

RELATION OF SUCKING HABIT TO
AGE OF WEANING IN MONTHS

WEANING AGE	up to 7	8 - 9	10 - 12	13 - 15	MEAN WEANING AGE
SAMPLE (n) 283	29	70	131	53	-
% RATE OF SUCKERS	41	41	32	36	10.9
NON SUCKERS	-	-	-	-	12.4 [£]

£ Weaning time among suckers is significantly shorter, 1-2 mo.

Source: Popovich, Study No. 1

DATA FILE TABLE NO. 11

RATES OF SUCKING HABITS AMONG CHILDREN
USING COMFORTERS, TEETHING RINGS OR NEITHER

HABIT	COMFORTER	TEETHING RING	NEITHER	TOTAL
SAMPLE	45	9	105	159
RATE OF SUCKING HABITS	20%	44% T	43%	36.5%

£ Significantly different from those using a teething ring or neither.

Source: Popovich, Study No. 1

Year	1950	1951	1952	1953	1954
Population	1,000,000	1,050,000	1,100,000	1,150,000	1,200,000
Area (sq. mi.)	10,000	10,000	10,000	10,000	10,000
Population Density	100	105	110	115	120

Source: U.S. Census Bureau, 1954

Table 1. Summary of Data

Year	1950	1951	1952	1953	1954
Population	1,000,000	1,050,000	1,100,000	1,150,000	1,200,000
Area (sq. mi.)	10,000	10,000	10,000	10,000	10,000
Population Density	100	105	110	115	120

Source: U.S. Census Bureau, 1954

Table 2. Summary of Data

Year	1950	1951	1952	1953	1954
Population	1,000,000	1,050,000	1,100,000	1,150,000	1,200,000
Area (sq. mi.)	10,000	10,000	10,000	10,000	10,000
Population Density	100	105	110	115	120

Source: U.S. Census Bureau, 1954

DATA FILE TABLE NO. 12

SUCKING HABIT PREVALENCE ACCORDING TO
ORDER OF BIRTH

ORDER OF BIRTH	1st	2nd	3rd	4th	5th,6,7
SAMPLE (n) 301	86	113	59	28	15
RATES OF SUCKERS	44%	37%	44%	43%	40%

Above rates non significant.

Source: Popovich, Study No. 1

DATA FILE TABLE NO. 13

PREVALENCE OF SUCKING HABIT ACCORDING TO
NUMBER OF CHILDREN IN FAMILY

	NUMBER OF CHILDREN IN FAMILY					
	1	2	3	4	5	6.7.8.9
SAMPLE (n) 299	25	135	83	23	22	11
RATE OF SUCKERS	28%	43%	46%	17%	41%	54%

Source: Popovich, Study No. 1

DATA FILE TABLE NO. 14

THREE SETS OF MANDIBULAR MEASUREMENTS
of
60 RANDOM THREE YEAR OLD AND 60 RANDOM SIX YEAR OLD CHILDREN

M A L E S

<u>THREE YEARS</u>				<u>SIX YEARS</u>			
CASE	1	2	3	CASE	1	2	3
Tom L.	37.7	7.2	11.7	John E.	40.0	8.9	13.0
	38.6	7.2	11.9		41.2	8.4	12.8
Rick D.	39.3	7.7	13.7	John M.	39.6	8.0	12.5
	39.0	6.9	13.5		38.0	7.2	12.3
Russ. R.	37.4	7.4	11.4	Bill O.	41.9	7.4	12.1
	37.0	7.6	11.4		44.6	7.6	11.8
Toni B.	39.2	6.9	12.4	James B.	38.8	7.3	12.3
	39.1	8.1	12.0		39.1	2.8	12.3
Ron. B.	35.5	6.9	11.2	Laur. B.	41.3	7.1	12.1
	35.2	7.2	11.1		39.3	7.0	12.4
Rick H.	34.5	6.9	10.8	Bob E.	42.1	8.5	13.5
	34.2	7.0	11.5		40.4	7.8	13.0
Glen O.	38.2	7.8	11.5	Dave D.	40.0	8.4	11.9
	38.5	8.4	12.2		39.6	7.3	12.3
Mark K.	42.9	7.2	12.7	Doug D.	41.0	7.2	12.6
	43.0	7.6	13.3		41.9	8.1	11.7
Kelv. F.	35.1	7.0	12.2	Ails. F.	39.2	7.0	12.2
	37.0	7.2	12.5		38.3	6.5	12.8
Paul B.	40.4	7.8	12.6	Terr. P.	38.2	8.0	12.5
	40.0	6.4	13.0		36.3	7.5	12.0
Terr. O.	37.0	7.0	11.8	Steph R.	39.0	7.5	12.5
	35.7	7.0	12.6		40.2	7.9	11.9
Roy T.	36.7	7.0	12.4	Don. S.	41.6	8.2	12.7
	37.3	6.8	12.5		40.3	7.9	12.8
Ted B.	36.2	6.4	11.3	Allan S.	41.1	7.6	13.2
	37.5	6.3	11.6		40.2	7.8	12.6
Jim B.	35.8	6.5	11.4	Dave S.	38.0	8.0	12.1
	37.4	7.5	11.9		36.7	7.5	12.5
Tim C.	35.9	6.3	12.2	Pete W.	39.3	7.7	12.1
	35.0	6.4	12.1		40.3	8.0	12.3
Bill K.	38.0	7.5	11.6	Tom B.	39.5	7.7	11.9
	36.6	7.0	11.4		40.1	7.5	12.5
Rob. E.	38.7	5.8	12.5	Brian M.	38.5	7.4	11.3
	36.9	6.3	12.2		37.5	7.2	11.0
Dan. C.	40.3	7.4	11.7	Dave L.	36.8	7.6	12.1
	40.0	7.7	11.4		38.4	7.4	12.2
Jim B.	38.6	7.2	12.6	Bill I.	42.4	8.0	12.1
	38.7	7.4	13.1		40.0	7.3	11.2
Bill E.	36.6	7.1	10.2	Doug H.	38.0	8.0	12.9
	36.2	6.8	10.3		38.4	8.2	12.2
Dar. F.	36.4	7.3	11.3	Bill H.	35.8	8.0	11.0
	36.5	7.7	11.3		37.3	9.0	11.3
Peter A.	40.4	8.3	12.1	John H.	40.0	4.5	12.7
	39.0	8.2	11.9		38.2	7.7	11.6

(Cont'd)

M A L E S (Cont'd)

THREE YEARSSIX YEARS

CASE	1	2	3	CASE	1	2	3
Jim F.	35.9 35.0	6.4 5.1	10.5 10.7	Dave G.	40.8 42.0	7.6 9.0	12.7 12.0
Doug K.	37.5 37.0	8.3 7.7	12.9 12.0	Bob G.	39.6 38.7	8.2 8.5	12.3 12.0
John H.	38.3 38.5	7.7 7.2	12.2 12.4	Don F.	38.0 37.4	8.0 8.0	11.9 12.0
John C.	36.4 37.7	7.2 6.9	12.1 12.3	Ross D.	41.3 41.7	7.8 8.4	12.6 12.0
Peter C.	38.8 39.0	7.8 8.2	11.8 11.8	Pete C.	39.5 38.4	7.0 8.0	12.7 12.8
John H.	36.6 35.7	7.8 7.3	11.6 11.5	Bob B.	41.4 40.4	8.0 7.3	12.8 12.7
Robt. T.	40.0 40.8	7.7 7.0	12.7 13.2	Barr D.	38.8 42.3	7.8 8.7	11.8 11.6
Brian M.	36.8 37.0	7.5 7.5	12.2 11.9	Midi G.	40.4 40.7	8.0 8.1	12.6 12.6

F E M A L E S

THREE YEARSSIX YEARS

CASE	1	2	3	CASE	1	2	3
Jan. S.	35.4 34.9	7.3 7.0	11.2 11.3	Mary B.	36.5 37.7	7.0 7.0	11.4 12.0
Pat W.	36.0 36.0	6.7 7.2	11.1 11.2	Kate B.	39.3 41.5	7.2 7.5	12.9 13.3
Ann W.	40.2 39.3	7.9 7.1	12.3 12.4	Mary B.	40.6 40.1	7.6 7.5	11.7 12.1
Lee F.	37.1 37.0	6.3 6.6	11.4 11.1	Diane E.	37.0 37.6	7.4 7.2	11.9 12.1
Sue F.	37.6 36.8	7.1 7.3	12.3 12.5	Lee T.	39.3 39.6	8.6 8.1	12.8 12.2
Shell M.	38.4 38.0	7.9 7.7	12.4 12.3	Ann W.	40.0 41.5	7.8 7.3	11.8 11.7
Sue A.	38.5 39.4	7.9 8.0	12.3 12.5	Jean R.	40.9 40.5	7.2 7.7	13.0 12.5
Paula H.	38.5 38.2	7.0 7.1	13.0 13.3	Clair W.	39.3 40.0	7.7 7.8	13.2 12.5
Cor. B.	39.1 38.4	7.1 7.3	12.1 12.7	Lesl P.	38.0 38.3	7.5 7.3	12.7 11.9
Nan. P.	37.5 36.5	7.0 7.1	11.6 11.8	Dor. R.	38.0 38.2	7.6 8.0	11.9 12.1
Shar. F.	38.1 38.6	7.3 7.0	12.5 12.3	Jan P.	37.8 38.7	7.5 7.8	12.4 12.3
Dorn. S.	35.0 37.3	6.9 7.3	11.5 11.3	Irene P.	42.5 37.1	7.6 7.2	11.8 12.0
Jan N.	37.3 37.7	7.0 7.6	11.8 11.8	Linda P.	34.1 34.6	6.8 7.0	12.4 11.9
Maur. E.	38.8 38.5	7.5 6.5	12.6 12.0	Jen. F.	40.2 38.5	7.8 7.2	12.1 12.7
Daphn F.	36.4 37.5	6.4 6.5	12.2 12.7	Ann W.	38.2 38.9	7.6 7.6	12.4 11.7

F E M A L E S (Cont'd)

THREE YEARSSIX YEARS

CASE	1	2	3	CASE	1	2	3
Murie B.	37.7 37.5	7.0 7.0	11.9 12.1	Jus. B.	38.5 38.3	7.0 7.3	12.7 12.7
Ann S.	41.7 40.7	7.8 7.3	12.8 12.3	Les B.	35.1 35.2	7.2 7.3	11.9 11.5
Nan. D.	36.2 36.1	6.7 6.7	11.7 10.7	Sand B.	38.4 39.5	7.9 8.6	11.6 11.7
Barb D.	38.7 37.0	7.7 7.7	12.1 12.2	Sue D.	40.3 39.4	8.0 8.2	12.0 12.1
Sue S.	38.0 36.9	7.3 7.2	12.1 11.9	Linda C.	36.8 38.2	7.8 7.0	11.9 12.1
Diane M.	39.7 39.9	7.1 7.5	11.6 11.4	Karen D.	35.8 34.8	7.2 6.2	12.5 11.4
Carla F.	36.0 36.4	6.9 6.8	11.2 11.6	Cor. C.	38.5 38.2	7.8 8.0	12.5 12.2
Barb T.	36.4 35.9	6.5 6.7	11.0 11.4	Dar. K.	38.0 37.5	7.3 6.7	12.5 12.0
Lois T.	37.9 39.0	7.1 7.6	13.0 13.2	Diane J.	37.4 37.5	7.2 7.8	11.8 12.0
Moirra J.	36.7 38.4	7.1 7.1	12.4 12.0	Jane J.	38.7 39.4	7.4 7.8	12.0 11.4
Sand. G.	37.7 38.2	6.8 6.7	11.8 12.0	Paul G.	39.5 40.2	7.2 7.2	12.0 12.0
Dana C.	37.0 37.4	6.5 6.9	11.5 11.5	Mary D.	36.7 37.2	7.4 7.0	11.1 11.5
Judy C.	37.0 37.0	6.5 6.5	11.4 11.9	Mary D.	38.4 38.4	7.1 6.9	11.2 12.0
Mary C.	37.8 39.1	6.7 6.7	11.8 12.0	G.	32.3 33.0	7.8 7.5	10.7 10.7
Coll. C.	35.7 36.2	7.0 7.3	11.2 12.5	Joan F.	38.1 38.9	7.4 7.3	12.6 12.6

Source: Hatton, Study No. 32

- 1 - Distance between the most mesial point on that border of the permanent cuspid and the most distal point on that border of the first permanent molar.
- 2 - Width of the permanent cuspid.
- 3 - Width of the permanent first molar

All measurements are in millimetres and are taken from oblique cephalograms.

Measurements of right side precede those of left side.

DATA FILE TABLE NO. 15

MEASUREMENTS OF LOWER FIRST PERMANENT MOLAR POSITIONS DERIVED FROM DUPLICATING THE CEPHALOGRAMS AND TRACINGS.

CASE	MESIO-DISTAL DISTANCE						CUSPID HEIGHT						MOLAR HEIGHT					
	Ceph I			Ceph II			S of S			Ceph I			Ceph II			S of S		
	T ₁	T ₂	T ₁	T ₂	for cephs	for trcgs	T ₁	T ₂	T ₁	T ₂	for cephs	for trcgs	T ₁	T ₂	T ₁	T ₂	for cephs	for trcgs
1	36.0	36.1	35.8	36.0	.0225 ⁺	.025	14.0	14.2	13.4	13.8	.2500	.1000	16.5	16.4	16.3	16.4	.0100	.0100
2	38.4	38.6	38.5	38.8	.0225	.065	14.1	13.9	14.4	14.8	.3600	.1000	18.0	18.0	17.6	17.7	.1225	.0050
3	38.3	38.5	37.8	37.5	.5630	.065	16.1	15.9	15.6	16.2	.0100	.2000	17.7	17.4	18.1	17.7	.1225	.1250
4	37.5	36.8	36.8	36.5	.1600	.250	13.0	13.4	14.1	13.6	.4225	.2050	16.5	16.7	16.4	16.8	0	.1000
5	37.7	37.6	37.6	37.5	.0100	.010	15.9	15.4	16.0	17.0	.7225	.6250	18.4	17.8	17.9	17.8	.0625	.1850
6	40.7	40.5	40.8	40.8	.0400	.020	11.5	11.9	12.7	12.3	.6400	.1600	17.7	17.1	16.6	16.5	.7225	.1850
7	37.7	38.5	38.1	37.9	.0100	.340	14.7	14.6	13.7	13.9	.7225	.0250	18.3	17.9	18.3	17.9	0	.1600
8	40.4	40.3	40.2	40.2	.0225	.005	15.4	15.0	15.4	14.9	.0025	.2050	17.7	17.6	16.6	16.9	.8100	.00500
9	39.4	38.7	38.5	38.5	.3025	.245	12.8	11.9	12.3	11.7	.1225	.5850	16.8	16.3	17.3	16.1	.0225	.8450
10	41.0	40.7	41.3	40.7	.0225	.225	13.7	12.9	12.9	12.5	.3600	.4000	16.0	16.4	15.9	15.8	.0100	.0100
11	36.3	35.8	35.9	35.9	.0225	.125	14.2	14.1	13.2	13.7	.4900	.1300	16.4	16.5	16.9	16.4	.04	.1300
12	36.4	36.0	36.2	36.3	.0025	.085	14.8	15.0	14.7	14.2	1.000	.1450	16.8	16.4	17.5	16.8	.3025	.3250
13	36.9	36.4	36.7	36.5	.0025	.145	15.4	15.3	15.6	15.4	.0225	.0250	17.6	17.7	17.4	17.6	.0225	.025
14	39.1	39.1	39.0	39.3	.0025	.045	13.7	13.9	13.9	13.6	.0025	.0650	18.2	18.5	17.7	17.4	.6400	.0900
15	42.3	42.3	42.3	42.7	.0400	.080	13.5	13.5	13.5	13.9	.0400	.0800	16.4	16.6	17.0	17.0	.2500	.0200

N = 15

Source: Hatton, Study No. 3.
 Estimate of variance (with one degree of freedom) - $\frac{(\text{difference of two totals})^2}{\text{e.g. } (14.0+14.2)-(13.4+13.8)} \div 2$
 number of observations 4

DATA FILE TABLE NO. 16

CHANGES IN THE POSITION OF THE SIX YEAR PERMANENT MOLAR ABOVE THE INFERIOR BORDER OF THE MANDIBLE IN A
 GROUP OF 17 FEMALES ALL AT AGES 3-5 YEARS
 (All measurements in mm.)

Case	Position at Visits I 3 yrs. 4 yrs. 5 yrs.	Increase in Ht. 1st-3rd Visit	Period in Mos. between Visits	Rate of Growth mm. per mos. between visits 1-3	Dec. Molar Height	Distance to be covered to Reach height of dec. molar from position 1st visit.
1	15.1	18.3	19.0	3.9	24	12.7
2	15.3	17.1	18.6	3.3	23	12.3
3	15.4	17.5	19.1	3.7	22	12.7
4	15.5	18.8	19.3	3.8	22	10.8
5	15.5	17.6	19.1	3.6	21	11.5
6	15.5	17.8	19.7	4.2	23	13.1
7	17.7	17.3	18.4	2.7	22	10.1
8	16.0	19.0	20.5	4.5	23	10.8
9	16.7	20.4	22.4	5.7	21	12.7
10	16.7	18.6	19.2	2.5	23	9.5
11	17.0	19.5	20.6	3.6	24	10.6
12	17.3	21.9	25.1	7.8	24	12.5
13	17.8	20.0	23.0	5.2	24	11.6
14	17.8	23.8	27.4	9.6	22	11.9
15	18.1	20.0	22.5	4.4	20	12.0
16	19.2	23.0	28.2	9.0	22	11.4
17	19.9	22.6	26.0	6.1	21	10.7

Source: Hatton, Study No. 4

DATA FILE TABLE NO. 17

CHANGES IN POSITION OF THE SIX YEAR PERMANENT MOLAR ABOVE THE INFERIOR BORDER OF THE MANDIBLE IN A
 GROUP OF 18 MALES ALL AT AGES 3-5 YEARS
 (All measurements in mm.)

Case	Position at Visits I II III	Increase in Ht. 1st-3rd Visit	Period in Mos. between Visits	Rate of Growth mm. per mos. between visits 1-3	Dec. Molar Height	Distance to be covered to Reach height of dec. molar from position 1st visit.		
1	14.9	17.7	20.1	5.2	24	.21	27.9	13.0
2	15.4	17.7	18.8	3.4	24	.15	25.9	10.5
3	16.4	18.3	19.3	2.9	24	.12	28.4	12.0
4	16.4	17.5	18.7	2.3	20	.12	27.4	11.0
5	16.4	18.6	20.6	4.2	21	.2	28.7	12.3
6	16.9	19.0	20.5	3.6	23	.15	30.4	14.0
7	17.3	19.9	21.6	4.3	24	.18	28.5	11.2
8	17.3	18.5	19.3	2.4	21	.12	28.4	11.1
9	17.5	20.3	22.8	5.3	21	.15	30.8	13.3
10	17.9	23.3	28.8	10.9	22	.5	29.0	11.1
11	18.4	21.7	24.6	6.2	20	.3	30.6	12.2
12	18.4	19.1	20.3	1.9	24	.08	29.9	11.5
13	18.4	20.4	23.8	5.4	21	.26	28.6	10.2
14	18.4	22.0	25.0	6.6	22	.3	29.3	10.9
15	18.4	20.9	22.3	3.9	24	.17	29.4	11.0
16	18.8	20.0	24.0	5.2	23	.23	30.8	12.0
17	19.4	21.2	23.1	3.7	24	.15	31.3	11.9
18	20.4	23.6	26.6	6.2	20	.3	32.2	11.8

Source: Hatton, Study No. 4

DATA FILE TABLE NO. 18

MEAN MANDIBULAR MEASUREMENTS FOR 3 YR. OLD + 6 YR. OLD CHILDREN

MEASUREMENTS OF RIGHT SIDE PRECEDE THOSE OF LEFT SIDE.

3 YR. OLDS						6 YR. OLDS					
Females N=30			Males N=30			Females N=30			Males N=30		
1	2	3	1	2	3	1	2	3	1	2	3
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
X Rt. 37.4	7.0	11.8	37.9	7.0	12.1	38.1	7.5	12.1	39.7	7.8	12.2
X Lt. 37.5	7.0	11.8	37.9	7.2	12.2	38.2	7.4	12.0	39.9	7.6	12.3
S Rt. 1.45	.43	.56	1.67	.53	.68	Not calculated			Not calculated		
S Lt. 1.35	.40	.54	1.52	.53	.71						

Source: Hatton, Study No. 4

x - Mean value S - Standard Deviation N - Number of cases

1 - Distance between the most mesial point on that border of the permanent cuspid and the most distal point on that border of the 6 year molar.

2 - Mesio-distal width of the permanent cuspid.

3 - Mesio-distal width of the 6 year molar.

DATA FILE TABLE NO. 19

Mean Anteroposterior Cephalometric Measurements

Along the Plane of the Bisector of the Palatal and Mandibular Planes

Characteristic	S E X	AGE LAST BIRTHDAY				P	
		3 yrs.	6 yrs.	8 yrs.	10 yrs.	Sex	Age
No. examined	M	24	25	25	15		
	F	25	25	25	15		
Sella to PTM	M	23.10 $\pm$.37	22.73 $\pm$.26	23.81 $\pm$.36	23.79 $\pm$.40	$\leq$.01	N.S.
	F	22.09 $\pm$.30	22.26 $\pm$.34	22.82 $\pm$.43	21.76 $\pm$.58	$\leq$.01	N.S.
PTM to Orbitale	M	31.04 $\pm$.35	33.38 $\pm$.50	35.66 $\pm$.45	35.29 $\pm$.77	$\leq$.05	$\leq$.01
	F	30.78 $\pm$.44	31.69 $\pm$.37	34.86 $\pm$.57	34.93 $\pm$.57	$\leq$.05	$\leq$.01
Orbitale to Nasion	M	6.51 $\pm$.41	7.57 $\pm$.55	5.70 $\pm$.53	8.49 $\pm$.55	N.S.	$\leq$.01
	F	6.36 $\pm$.44	7.90 $\pm$.48	5.91 $\pm$.48	7.74 $\pm$.85	N.S.	$\leq$.01
Sella to Nasion	M	60.57 $\pm$.53	63.55 $\pm$.51	65.17 $\pm$.56	57.58 $\pm$.78	$\leq$.01	$\leq$.01
	F	59.22 $\pm$.43	61.80 $\pm$.49	63.51 $\pm$.57	64.43 $\pm$.94	$\leq$.01	$\leq$.01
Nasion to "A"	M	9.41 $\pm$.35	10.14 $\pm$.50	11.43 $\pm$.74	11.48 $\pm$.64	N.S.	$\leq$.01
	F	8.96 $\pm$.50	10.60 $\pm$.60	10.90 $\pm$.46	11.62 $\pm$.81	N.S.	$\leq$.01
"E" to Orbitale	M	11.06 $\pm$.36	8.13 $\pm$.39	7.43 $\pm$.52	4.38 $\pm$.70	N.S.	$\leq$.01
	F	11.27 $\pm$.40	7.71 $\pm$.52	7.59 $\pm$.60	5.07 $\pm$.74	N.S.	$\leq$.01

Source: Spracklin, Study No. 8

DATA FILE TABLE NO. 20

Mean Cephalometric Angular Measurements

In Degrees by Age and Sex

Characteristic	SEX	Age Last Birthday			
		3 yrs.	6 yrs.	8 yrs.	10 yrs.
No. examined	M	24	25	25	15
	F	25	25	25	15
Palatal Bolton Angle	M	23.30 $\pm$.47	23.93 $\pm$.59	24.42 $\pm$.54	23.31 $\pm$.69
	F	23.81 $\pm$.51	23.32 $\pm$.67	23.50 $\pm$.59	24.35 $\pm$.85
Occlusal Bolton Angle (££)	M	40.65 $\pm$.84	37.71 $\pm$.63	36.70 $\pm$.56	34.12 $\pm$ 1.13
	F	39.64 $\pm$.73	36.64 $\pm$.80	35.93 $\pm$.69	36.39 $\pm$.81
Bisector Bolton Angle	M	38.03 $\pm$.45	37.42 $\pm$.65	38.37 $\pm$.50	37.47 $\pm$.80
	F	37.71 $\pm$.56	37.49 $\pm$.74	37.57 $\pm$.41	38.68 $\pm$.76
Mandibular Bolton Angle	M	52.73 $\pm$.72	51.13 $\pm$.91	51.82 $\pm$.71	51.51 $\pm$ 1.23
	F	51.40 $\pm$.87	51.90 $\pm$ 1.12	50.50 $\pm$.63	53.03 $\pm$ 1.04

Source: Spracklin, Study No. 8

£ Standard error of mean.

(££) Occlusal bolton angle significantly different with age,
p .05.

DATA FILE TABLE NO. 21

Correlations between Angles of the Palatal Plane, the
Occlusal Plane, and the Mandibular Plane to the Cranial Base

By Age and Sex

Age	Sex	No.	Palatal Bolton Angle to Occlusal Bolton Angle	Occlusal Bolton Angle to Mandibular Bolton Angle	Palatal Bolton Angle to Mandibular Bolton Angle
			r	r	r
3	M	25	.353 ^{££}	.603 ^{££}	.012 [£]
	F	25	.569 ^{££}	.711 ^{££}	.431 [£]
6	M	25 ^{££}	.601 ^{££}	.709	.368
	F	25	.358 ^{££}	.818	.321
8	M	25	.301	.378	.293
	F	25	.099	.512 ^{££}	-.094
10	M	15	.526 [£]	.555 [£]	.311
	F	15	.494	.558 [£]	.282

Source: Spracklin, Study No. 8

£ Correlations significant at 5% level of confidence.

££ Correlations significant at the 1% level of confidence.

TABLE 1

Comparison of the results of the 1950 and 1951 censuses of the population of the United States, by race, sex, and age, and by marital status, for the total population, and for the population 18 years of age and over.

Age	Sex	Marital Status	1950	1951	Change
Total	Total	Total	151,326,000	152,266,000	940,000
Total	Total	Married	100,000,000	100,500,000	500,000
Total	Total	Single	40,000,000	40,000,000	0
Total	Total	Widowed	10,000,000	10,000,000	0
Total	Total	Divorced	1,326,000	1,766,000	440,000
White	Male	Married	60,000,000	60,500,000	500,000
White	Male	Single	20,000,000	20,000,000	0
White	Male	Widowed	5,000,000	5,000,000	0
White	Male	Divorced	500,000	700,000	200,000
White	Female	Married	40,000,000	40,500,000	500,000
White	Female	Single	15,000,000	15,000,000	0
White	Female	Widowed	5,000,000	5,000,000	0
White	Female	Divorced	326,000	566,000	240,000
Nonwhite	Male	Married	40,000,000	40,000,000	0
Nonwhite	Male	Single	20,000,000	20,000,000	0
Nonwhite	Male	Widowed	5,000,000	5,000,000	0
Nonwhite	Male	Divorced	826,000	1,066,000	240,000
Nonwhite	Female	Married	30,000,000	30,500,000	500,000
Nonwhite	Female	Single	15,000,000	15,000,000	0
Nonwhite	Female	Widowed	5,000,000	5,000,000	0
Nonwhite	Female	Divorced	500,000	766,000	266,000

Source: U.S. Census Bureau, "Marriage, Divorce, Remarriage in the United States," Current Population Reports, Series 30-10, 1950 and 1951.

DATA FILE TABLE NO. 22

Estimates of Constants in Linear Equation Expressing the Position
of Points on the Occlusal Plane as Related to the Bisector of the
Palatal Mandibular Plane Angles and Orbitale

Age	Male		Female	
	a	b(slope)	a	b(slope)
3 yrs.	+5.40	-.047 $\pm$.057 [£]	+5.62	-.041 $\pm$.048
6 yrs.	+5.33	+.000(4) $\pm$.041	+5.63	+.014 $\pm$.051
8 yrs.	+8.24	+.027 $\pm$.051	+8.24	+.028 $\pm$.060
10 yrs.	+6.23	+.068 $\pm$.055	+5.77	+.051 $\pm$.042

Source: Spracklin, Study No. 8

Y = a + bX where X is anteroposterior distance along
the bisector plane; a is the vertical inter-
cept of the occlusal plane at orbitale and
b is the slope of the average occlusal plane
to the bisector plane.

£ standard error of the slope.

DATA FILE TABLE NO. 23

Average Heights in Millimeters of the Deciduous Teeth
Above the Bisector of the Palatal Mandibular Plane Angle
by Age and Sex

	Age 3	Age 6	Age 8	Age 10
Males	5.292 $\pm$.124 [£]	5.533 $\pm$.148	7.741 $\pm$.150	6.768 $\pm$.191
Females	5.699 $\pm$.099	5.700 $\pm$.128	8.368 $\pm$.166	6.156 $\pm$.159

Source: Spracklin, Study No. 8

£ Standard error of pooled y values

DATA FILE TABLE NO. 24

Ranges of Average Heights in Millimeters

Above the Plane of the Bisector of the Palatal Mandibular Angle
of sets of Points on their Occlusal Planes of Individual Children
by Age and Sex

Sex	Age 3	Age 6	Age 8	Age 10
Males	+4.1	+1.5	+ 5.0	+4.1
	to	to	to	to
	+6.6	+6.8	+10.0	+8.4
Females	+ 4.5	+3.1	+ 5.6	+4.9
	to	to	to	to
	+7.0	+7.3	+10.7	+7.2

Source: Spracklin, Study No. 8

Table No. 24

Number of persons in military

above the rank of the lowest of the military hierarchy
of state of persons in their General Plans of Individual Obligations

by age and sex

Sex	Age 1	Age 2	Age 3	Age 4
Male	- 1.1	1.1	1.1	1.1
	to	to	to	to
Female	+ 1.1	+ 1.1	+ 1.1	+ 1.1
	to	to	to	to

Source: Statistical Yearbook

DATA FILE TABLE NO. 25

Range of Individual Least Squares Slopes of Occlusal
Planes to the Plane of the Bisector of the Palatal Mandibular Angle

Item	S E X	Age 3	Age 6	Age 8	Age 10
Lowest slope	M a l e	-.165	-.065	-.106	-.033
to		to	to	to	to
Highest slope		+ .059	+ .072	+ .137	+ .159
Range in degrees		12.6°	7.9°	13.9°	11.0°
Lowest slope	F e m a l e	-.107	-.073	-.121	-.016
to		to	to	to	to
Highest slope		+ .037	+ .123	+ .125	+ .110
Range in degrees		8.2°	11.3°	14.0°	7.2°

Source: Spracklin, Study No. 8

DATA FILE TABLE 26(a)
 CEPHALOMETRIC MEASUREMENT OF 51 THREE YEAR OLD CHILDREN
 AND THE PROBABILITIES FOR OBSERVED DIFFERENCES BY OCCLUSION TYPE AND SEX

TABLE 1

MEASUREMENTS	NORMAL OCCLUSION		POSTNORMAL OCCLUSION		PROB. OF AV. WT'D DIFF. BET. OCCL. TYPES	PROB. OF MEAN DIFF. WITHIN SEXES
	15 MALES	15 FEMALES	15 MALES	6 FEMALES		
Angles						
Sella N Basion	17.2 ± .54	17.0 ± .52	16.0 ± .47	17.5 ± 1.02		
Basion N a	63.5 ± .88	62.7 ± .72	61.9 ± .79	61.8 ± 1.16		
N Basion Mand.	53.5 ± .82	52.5 ± .92	51.2 ± .73	51.0 ± 1.76	<.05	<.05
N Basion Occlusal	38.7 ± .77	37.5 ± .91	40.0 ± .87	38.3 ± .56		
Occlusal Mand.	14.9 ± .76	15.3 ± .79	12.3 ± .84	13.2 ± 1.64	<.02	<.05
Condylar Angle	133.5 ± 1.16	136.0 ± 1.62	130.3 ± 1.32	128.7 ± 2.77	<.01	<.05
a to "a" plane	17.1 ± 1.43	19.1 ± 1.43	12.7 ± 2.06	14.5 ± 3.55	<.05	<.1
a to "b" plane	11.5 ± 1.25	12.7 ± 2.01	13.7 ± 1.65	17.8 ± 3.08		
Basion Palatal	26.9 ± .81	25.8 ± .78	27.1 ± .86	27.6 ± 2.56		
Linear Measurements						
"b" point "a" plane	-.3 ± .52	0 ± .55	-2.8 ± .61	-2.3 ± .71	<.01	<.01
Gnathion "a" plane	-1.5 ± .68	-.9 ± .46	-3.7 ± .79	-2.3 ± .91	<.02	<.001
e to "a" plane	24.2 ± .34	23.7 ± .47	23.8 ± .21	23.0 ± .44		<.2
Mandibular Length	85.9 ± .93	85.0 ± 1.11	83.3 ± 1.82	80.2 ± 2.88		
e to "b" plane	22.7 ± .36	22.1 ± .45	22.5 ± .51	22.5 ± .67	<.05	<.001
Mand. Body Length	58.7 ± 1.05	56.8 ± .70	56.3 ± 1.51	54.8 ± 3.28		

Date		Time		Place		Remarks	
1911	10/10	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/11	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/12	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/13	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/14	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/15	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/16	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/17	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/18	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/19	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/20	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/21	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/22	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/23	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/24	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/25	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/26	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/27	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/28	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/29	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/30	10:00	10:15	10:30	10:45	11:00	11:15
1911	10/31	10:00	10:15	10:30	10:45	11:00	11:15

DATA FILE TABLE NO. 26 (b)
 CEPHALOMETRIC MEASUREMENT OF 51 THREE YEAR OLD CHILDREN
 AND THE PROBABILITIES FOR OBSERVED DIFFERENCES BY OCCLUSION, TYPE AND SEX

TABLE 1 CONTINUED

MEASUREMENTS	NORMAL OCCLUSION		S D	POSTNORMAL OCCLUSION		S D	PROB. OF AV. WT'D. DIFF. BETWEEN OCCL. TYPES	PROB. OF MEAN DIFF. WITHIN SEXES
	15 MALES	15 FEMALES		15 MALES	6 FEMALES			
<u>Linear Measurements</u> cont'd								
Ramus Height	42.9 ± 1.38 ^f	42.1 ± .75 ^f		43.8 ± .93 ^d	41.6 ± .54 ^e			
a to "a" plane	3.3 ± .65	4.3 ± .38		2.6 ± .42	.16 ± 1.57		<.01	<.01
a to "b" plane	.8 ± .44	.27 ± .45		1.0 ± .21	.67 ± .71			
Ant. face Height	96.5 ± .87	94.3 ± .83		96.8 ± .86	92.4 ± 1.13			
Upper	42.1 ± .78	40.6 ± .47		42.1 ± 1.0	41.6 ± 1.09			
Lower	54.4 ± .88	53.7 ± .83	#	54.6 ± 1.43	50.8 ± 4.47	#	<.02	<.01
Ratio of Lower	56.4 ± .52	56.8 ± .56	#	66.3 ± .83	54.8 ± 2.90	#		
Post. Face Height	54.9 ± .76	53.3 ± .87	#	56.5 ± .91	52.8 ± 2.3	#		
Lower	24.1 ± 1.27	23.1 ± 1.32		25.3 ± .60	24.3 ± 3.37			
Ratio of Lower	43.5 ± .88	42.9 ± 1.76		44.9 ± 1.21	44.8 ± 3.31			
Sella to Nasion	66.3 ± 1.36	64.2 ± 1.28		66.9 ± 1.19	65.4 ± .89			
PtM. to "a" point	46.4 ± .78	44.5 ± .87		45.7 ± .55	45.5 ± 1.92			
Condyle to PtM.	30.5 ± .56	31.2 ± 1.41		32.9 ± .68	30.4 ± 2.25	#	<.02	<.01

^f Standard Error of the Mean
 SD Sex Differences (Significant)

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DATA FILE TABLE NO. 27

TABLE 11

Lateral Cephalometric Measurements of Facial Dimensions of 30 Three Year Old Children Possessing Normal Occlusion	
15 Males 15 Females	
<u>Angular Measurements</u>	
Sella N B asion	17.1 $\pm$.37
Basion N a	63.1 $\pm$.59
Bolton N a	65.7 $\pm$.54
N Basion Mand.	53.0 $\pm$.58
N Basion Occl.	38.1 $\pm$.60
Occlusal Mand.	15.11 $\pm$.54
Condylar Angle	134.7 $\pm$ 1.28
a to "a" plane	18.1 $\pm$ 1.03
a to "b" plane	12.1 $\pm$ 1.17
Basion Palatal	26.4 $\pm$.67
<u>Linear Measurements</u>	
"b" point to "a" plane	-.13 $\pm$.37
Gnathion "a" plane	-1.23 $\pm$.51
e to "a" plane	23.9 $\pm$.28
e to "b" plane	22.4 $\pm$.29
Mandibular Length	85.5 $\pm$ 1.13
Mand. Body Length	57.7 $\pm$.59
Ramus Height	42.5 $\pm$.76
a to "a" plane	3.7 $\pm$.37
a to "b" plane	.53 $\pm$.26
Ant. Face Height	95.4 $\pm$.53
Upper	41.3 $\pm$.47
Lower	54.1 $\pm$.60
Ratio of Lower	56.6 $\pm$.36
Post. Face Height	54.1 $\pm$ 1.02
Lower	23.6 $\pm$.93
Ratio of Lower	43.2 $\pm$ 1.23
Sella Nasion	65.2 $\pm$.94
PtM to "a" point	45.4 $\pm$.59
Condyle to PtM	30.9 $\pm$.42

Source: Perry, Study No. 6

DATA FILE TABLE NO. 28

MEAN FACIAL DIMENSIONS IN DEGREES DERIVED FROM TRACINGS OF LATERAL CEPHALOGRAMS FOR FOUR GROUPS OF FIFTEEN
THREE YEAR OLD CHILDREN ARRANGED ACCORDING TO SEX AND TYPE OF OCCLUSION

Angle	Clinically Excellent Dentitions		Class II, Division 1 Malocclusions		Probability of Difference Due to Chance	
	Males	Females	Males	Females		
Sella-Nasion-"a" point	81.9 $\pm$ 1.25 ^f	81.8 $\pm$ 1.17	79.9 $\pm$.86	82 $\pm$ 1.33	-	-
Basion-Nasion-"a" point	65.2 $\pm$.99	65 $\pm$.93	64.4 $\pm$.88	66.3 $\pm$.94	-	-
Nasion-Basion Occlusal	38.7 $\pm$.64	38.9 $\pm$.77	38 $\pm$.70	37.3 $\pm$ 1.06	-	-
Nasion Basion- Mandibular	50 $\pm$ 1.17	50.7 $\pm$ 1.18	51 $\pm$ 1.11	50.9 $\pm$ 1.57	-	-
Mandibular-Occlusal	10.3 $\pm$ 1.06	10.9 $\pm$.87	11.9 $\pm$.83	11.8 $\pm$ 1.1	-	-
Maxillary incisors to Occlusal	64.6 $\pm$ 1.2	66.8 $\pm$ 1.6	60.7 $\pm$ 1.9	62 $\pm$ 1.26	-	.01
Mandibular incisors to Occlusal	77.4 $\pm$ 1.39	78 $\pm$ 1.56	75.7 $\pm$ 1.93	76.3 $\pm$ 1.57	-	-
Condylar angle	133.2 ^f .86	132.9 $\pm$ 1.65	134.9 $\pm$ 1.22	133.3 ^f .56	-	-

^f Standard error of the mean

Source: Mitchell, Study No. 7

TABLE II
MEAN FACIAL DIMENSIONS DERIVED FROM TRACINGS OF LATERAL CEPHALOGRAMS OF FOUR GROUPS OF FIFTEEN THREE YEAR OLD CHILDREN ARRANGED ACCORDING TO SEX AND TYPE OF OCCLUSION

Measurement in mm.	Clinically Excellent Dentitions		Class II, Division 1 Malocclusions		Probability of Difference Due to Chance	
	Males	Females	Males	Females	Sex	Occlusion
Maxillary incisor tip to "a" plane	4.03 ± .30 ^f	3.5 ± .33	4.83 ± .39	4.7 ± .48	-	<.05
Mandibular incisor apice to "a" plane	-1.6 ± .39	-1.06 ± .34	-4.83 ± .38	-5.8 ± .39	-	<.01
Mandibular incisor tip to "a" plane	1.9 ± .40	1.5 ± 2.9	-2.3 ± .48	-2.3 ± .50	-	<.01
"a" plane to "b" point	.96 ± .35	1.6 ± .13	-2.6 ± .45	-3.2 ± .50	-	<.01
"a" plane to Gnathion	-.23 ± .67	.06 ± .52	-3.3 ± .54	-4.2 ± .58	-	<.01
Pterygomax. fissure to <u>e</u>	22.4 ± .50	21.1 ± .49	23.2 ± .60	24.2 ± .60	-	<.05
Ptm. to "a"	45.3 ± .54	43.1 ± .43	46.1 ± .65	47.1 ± .61	-	<.01
Ptm. to Condyle	32.6 ± .94	31.4 ± .71	32.3 ± 1.82	32.7 ± .99	-	-
Ptm. to <u>e</u>	24.2 ± .48	23.5 ± .46	21.8 ± .62	22.5 ± .74	-	<.01
<u>e</u> to <u>c</u>	16.9 ± .28	16.3 ± .34	16.8 ± .35	16.4 ± .25	-	-
<u>e</u> to <u>a</u>	22.9 ± .32	22.4 ± .4	23.1 ± .45	21.4 ± .42	.05	-
<u>e</u> to <u>c</u>	16.9 ± .61	15.9 ± .35	16.5 ± .35	16.4 ± .28	-	-

^f Standard Error of the Mean

Source, Mitchell, Study No. 7.

No.	Name	Age	Sex	Height		Weight		Remarks
				cm	in	kg	lb	
1	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
2	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
3	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
4	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
5	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
6	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
7	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
8	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
9	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
10	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
11	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
12	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
13	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
14	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
15	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
16	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
17	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
18	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
19	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb
20	John	15	M	170	67	65	143	170 cm, 67 in, 65 kg, 143 lb

John's height is 170 cm.

John's weight is 65 kg.

TABLE III

MEAN FACIAL DIMENSIONS DERIVED FROM TRACINGS OF LATERAL CEPHALOGRAMS AND FROM MODELS OF FOUR GROUPS OF FIFTEEN THREE YEAR OLD CHILDREN ARRANGED ACCORDING TO SEX AND TYPE OF OCCLUSION

Measurement in mm.	Clinically Excellent Dentitions		Class II, Division I Malocclusions		Probability of Difference Due to Chance	
	Males	Females	Males	Females		
Ramus length	44.9 $\pm$ 1.1 ^f	42.8 $\pm$.88	42.8 $\pm$.80	42.5 $\pm$ 1.07	-	-
Body length	56.4 $\pm$.95	56.6 $\pm$.73	55.4 $\pm$.57	56.4 $\pm$.45	-	-
Mand. length on mand. plane	86.5 $\pm$ 1.34	83.6 $\pm$.41	84.4 $\pm$ 1.01	84.6 $\pm$ 1.39	-	-
Mand. length on occlusal plane	80.2 $\pm$ 1.07	78.6 $\pm$.88	77 $\pm$ 1.03	78 $\pm$.94	-	.05 < .1
Direct mand. length	92.6 $\pm$ 1.63	89.7 $\pm$.75	89.6 $\pm$.99	90 $\pm$ 1.26	-	-
Condyle to "a"	77.7 $\pm$ 1.17	75.4 $\pm$.85	78.4 $\pm$ 1.02	79.9 $\pm$ 1.13	-	< .05
Maxilla - model c to c width	29.0 $\pm$.38	28.1 $\pm$.46	27.3 $\pm$.56	25.8 $\pm$.35	< .01	< .01
e to e width	38.5 $\pm$.48	37.2 $\pm$.51	36.7 $\pm$.56	34.9 $\pm$.50	< .01	< .01
Mandible - model c to c width	23.2 $\pm$.48	22.4 $\pm$.4	22.6 $\pm$.55	22.3 $\pm$.29	-	-
e to e width	36.4 $\pm$.40	35.4 $\pm$.56	34.9 $\pm$.30	34.9 $\pm$.44	-	< .05

^f Standard Error of the Mean

Source: Mitchell, Study 7.

DATA FILE TABLE NO. 33

TABLE IV
MEAN FACIAL DIMENSIONS IN DEGREES DERIVED FROM TRACINGS OF LATERAL CEPHALOGRAPHS FOR COMPARISON WITHIN SEXES AND BETWEEN OCCLUSIONS FOR FOUR GROUPS OF FIFTEEN THREE YEAR OLD CHILDREN

Angle	Males		P	Females		P
	Class I, Division 1	Class II, Division 1		Class I, Division 1	Class II, Division 1	
Sella-Nasion-"a" point	81.9 $\pm$ 1.25 ^f	79.9 $\pm$.86	.1 < .2	81.8 $\pm$ 1.17	82 $\pm$ 1.33	-
Basion-Nasion-"a" point	65.2 $\pm$.99	64.4 $\pm$.88	-	65 $\pm$.93	66.3 $\pm$.94	-
Nasion-Basion-Occlusal	38.7 $\pm$.64	38 $\pm$.70	-	38.9 $\pm$.77	37.3 $\pm$ 1.06	-
Nasion-Basion-Mandibular	50 $\pm$ 1.17	51 $\pm$ 1.11	-	50.7 $\pm$ 1.18	50.9 $\pm$ 1.57	-
Mandibular-Occlusal	10.3 $\pm$ 1.06	11.9 $\pm$.83	.2 < .3	10.9 $\pm$.87	11.8 $\pm$ 1.1	.5 < .6
Maxillary incisors to Occlusal	64.6 $\pm$ 1.2	60.7 $\pm$ 1.9	.05 < .1	66.8 $\pm$ 1.6	62 $\pm$ 1.26	<.01
Mandibular incisors to Occlusal	77.4 $\pm$ 1.39	75.7 $\pm$ 1.93	.4 < .5	78 $\pm$ 1.56	76.3 $\pm$ 1.57	.4 < .5
Condylar angle	133.2 $\pm$.86	134.9 $\pm$ 1.22	.2 < .3	132.9 $\pm$ 1.65	133.3 $\pm$.56	-

^f Standard error of the mean.

P The probability of the difference due to chance.

DATA FILE TABLE NO. 34

TABLE V

MEAN FACIAL DIMENSIONS IN MILLIMETERS DERIVED FROM TRACINGS OF LATERAL CEPHALOGRAMS FOR COMPARISON WITHIN SEXES AND BETWEEN OCCLUSIONS FOR FOUR GROUPS OF FIFTEEN THREE YEAR OLD CHILDREN.

Measurement	Males		P	Females		P
	Clinically Excellent	Class II, Division 1		Clinically Excellent	Class II, Division 1	
Maxillary incisor tip to "a" plane	4.03 $\pm$.30 ^F	4.83 $\pm$.39	.1 < .2	3.5 $\pm$.33	4.7 $\pm$.48	< .05
Mandibular incisor apice to "a" plane	-1.6 $\pm$.39	-4.83 $\pm$.38	< .01	-1.06 $\pm$.34	-5.8 $\pm$.39	< .01
Mandibular incisor tip to "a" plane	+1.9 $\pm$.40	-2.3 $\pm$.48	< .01	1.5 $\pm$ 2.9	-2.3 $\pm$.50	< .01
"a" plane to "b" point	+3.96 $\pm$.35	-2.6 $\pm$.45	< .01	1.6 $\pm$.13	-3.2 $\pm$.50	< .01
"a" plane to Gnathion	-.23 $\pm$.67	-3.3 $\pm$.54	< .01	.06 $\pm$.52	-4.2 $\pm$.58	< .01
Pterygomax. fissure to <u>e</u>	22.4 $\pm$.50	23.2 $\pm$.60	.2 < .3	21.1 $\pm$.49	24.2 $\pm$.60	< .01
Ptm. to "a"	45.3 $\pm$.54	46.1 $\pm$.65	.3 < .4	43.1 $\pm$.43	47.1 $\pm$.61	< .01
Ptm. to Condyle	32.6 $\pm$.94	32.3 $\pm$ 1.82	-	31.4 $\pm$.71	32.7 $\pm$.99	.2 < .3
Ptm. to <u>e</u>	24.2 $\pm$.48	21.8 $\pm$.62	< .01	23.5 $\pm$.46	22.5 $\pm$.74	.2 < .3
<u>e</u> to <u>c</u>	16.9 $\pm$.28	16.8 $\pm$.35	-	16.3 $\pm$.34	16.4 $\pm$.25	-
<u>e</u> to <u>a</u>	22.9 $\pm$.32	23.1 $\pm$.45	-	22.4 $\pm$.4	21.4 $\pm$.42	.05 < .1
<u>e</u> to <u>c</u>	16.9 $\pm$.61	16.5 $\pm$.35	-	15.9 $\pm$.35	16.4 $\pm$.28	-

^F Standard error of the mean.

Source, Mitchell, Study 7.

DATA FILE TABLE NO. 35

TABLE VI

MEAN FACIAL DIMENSIONS IN MILLIMETERS DERIVED FROM TRACINGS OF LATERAL CEPH LOGRAMS AND MODELS FOR COMPARISON WITHIN SEXES AND BETWEEN OCCLUSIONS FOR FOUR GROUPS OF FIFTEEN THREE YEAR OLD CHILDREN

Measurement	Males		P	Females		P
	Clinically Excellent	Class II, Division 1		Clinically Excellent	Class II, Division 1	
Ramus length	44.9 $\pm$ 1.1 ^f	42.8 $\pm$.80	.1 < .2	42.8 $\pm$.88	42.5 $\pm$ 1.07	-
Body length	56.4 $\pm$.95	55.4 $\pm$.57	.3 < .4	56.6 $\pm$.73	56.4 $\pm$.45	-
Mand. length on mand. plane	86.5 $\pm$ 1.34	84.4 $\pm$ 1.01	-	83.6 $\pm$.41	84.6 $\pm$ 1.39	-
Mand. length on occlusal plane	80.2 $\pm$ 1.07	77 $\pm$ 1.03	.05 < .1	78.6 $\pm$.88	78 $\pm$.94	-
Direct mand. length	92.6 $\pm$ 1.63	89.6 $\pm$.99	-	89.7 $\pm$.75	90 $\pm$ 1.26	-
Condyle to "a"	77.7 $\pm$ 1.17	78.4 $\pm$ 1.02	-	75.4 $\pm$.85	79.9 $\pm$ 1.13	< .01
Maxilla-model c to c width	29.0 $\pm$.38	27.3 $\pm$.56	< .05	28.1 $\pm$.46	25.8 $\pm$.35	< .01
e to e width	38.5 $\pm$.48	36.7 $\pm$.56	< .05	37.2 $\pm$.51	34.9 $\pm$.50	< .01
Mandible-model c to c width	23.2 $\pm$.48	22.6 $\pm$.55	-	22.4 $\pm$.4	22.3 $\pm$.29	-
e to e width	36.4 $\pm$.40	34.9 $\pm$.30	< .05	35.4 $\pm$.56	34.9 $\pm$.44	.4 < .5

f Standard error of the mean

Source: Mitchell, Study 7

DATA FILE TABLE NO. 36

ANGULAR MEASUREMENT				
SEX	PALATAL OCCLUSAL	OCCLUSAL MANDIBULAR	PALATAL MANDIBULAR	RATIO PALATAL OCCLUSAL TO PALATAL MANDIBULAR
MALES	12.24 $\pm$ 2.91 ^f	15.00 $\pm$ 3.00	27.24 $\pm$ 3.46	0.45 $\pm$ 0.09 ^{f&}
FEMALES	11.69 $\pm$ 3.95	14.57 $\pm$ 3.36	26.26 $\pm$ 4.53	0.44 $\pm$ 0.111

Source: Landsberg: Study No. 9

^f Standard deviation in degrees
^{f&} Standard deviation in ratio

DATA FILE TABLE 37

SHOWING RESULTS OBTAINED USING VARIOUS REFERENCE PLANES TO STUDY a - b DIFFERENCES

MALES			
PLANE USED	PALATAL MANDIBULAR BISECTOR	CRANIAL (POPOVICH)	PATIENTS OCCLUSAL
MEAN	2.404	3.100	1.692
RANGE	-2.8 to 5.1	-.9 to 7	-2.5 to 6
VARIANCE	3.5254	4.1825	4.57
STANDARD DEVIATION	1.88	2.04	2.14
COEFFICIENT OF VARIANCE	78%	66%	80%

DATA FILE TABLE 38

SHOWING RESULTS OBTAINED USING VARIOUS REFERENCE PLANES TO STUDY a - b DIFFERENCES

FEMALES			
PLANE USED	PALATAL MANDIBULAR BISECTOR	CRANIAL (POPOVICH)	PATIENTS OCCLUSAL
MEAN	2.472	3.82	1.284
RANGE	-2.0 to 8.1	0.2 to 8.0	-4.8 to 4.2
VARIANCE	6.577	5.561	5.141
STANDARD DEVIATION	2.56	2.36	2.28
COEFFICIENT OF VARIANCE	97%	62%	77%

Source: Landsberg, Study No. 9

DATA FILE TABLE 39

DESCENDING RANK OF PROGNATHISM AS DETERMINED EMPLOYING SEVERAL REFERENCE PLANES
AND AN ANGULAR SYSTEM

Natural Occlusal as Reference Plane	Palatal Mandibular Bisector as Reference Plane	40 Degree Angle to Bolton Plane as Reference Plane	SNa - SNb Angular System
1	4	1	1
2	10	13	9
3	3	4	10
4	2	7	7
5	4	3	13
6	8	10	17
7	9	2	3
8	25	25	25
9	10	21	19
10	4	20	20
11	13	9	4
11	16	5	6
11	14	10	2
14	1	5	12
15	20	23	24
15	15	16	5
17	10	14	8
18	23	12	16
19	7	16	11
19	16	8	13
21	16	15	13
22	16	16	23
23	21	16	17
24	22	24	20
25	24	22	
Rank Correlation to Natural Occlusal Plane System	$r = + .645$	$r = + .539$	$r = + .393$

for 23 degrees of freedom r greater than .396 is significant at 5% level, and greater than .505 at 1% level. Source: Landsberg, Study No. 9.

BURLINGTON ORTHODONTIC
RESEARCH CENTRE

Progress Report Series

No. 2

1956 to 1957

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Division of Dental Research
Faculty of Dentistry
University of Toronto
November, 1957.

BURLINGTON ORTHODONTIC

RESEARCH CENTRE

Report Series No. 2

ANNUAL MEETING

November 7, 1957.

136 Brant Street, Burlington.

Research Division

Faculty of Dentistry

University of Toronto.

PROGRAM of
ANNUAL MEETING

136 Brant Street, Burlington

10.30 A.M. Nov. 7th, 1957

- I Introductory remarks (Dr.G.Nikiforuk)
 History of Project, purpose, staff, budget.
- II Progress Report (Dr.F.Popovich)
- III Public Health Value of Project (R.M.Grainger)
- IV Growth and Development Studies (Dr.M.Hatton)
- V General Discussion

This publication comprises the second of the report series on the Burlington Orthodontic Research Center for presentation at the annual meeting. Future findings will be reported annually in a similar fashion.

STAFF

The staff of the Orthodontic Research Center has remained unchanged since last year's report with the exception of a few adjustments in times.

Treatment is being conducted for a total of $2\frac{1}{2}$ days per week by Dr.'s F. Popovich, M. Johnston, L. Scott, and R. Boyko. Records (i.e. impressions and radiographs) are taken for a total of $2\frac{1}{2}$ days per week by Dr.'s B. Morrow, W. Feasby and R. Boyko. In addition to the clinical work, preparation of tracings and measurements have been carried out by Dr.'s F. Popovich, M. Johnston, R. Boyko, and Dr. M. Hatton, geneticist. Dr. Hatton has also continued pilot studies on growth and development of the face. All processing of records (i.e. pouring and trimming models, development of films, filing etc.), dental assisting, fabrication of appliances, and office work has been carried out by Mrs. M. Holbrook and Mrs. K. Scarlett. Dr. R. M. Grainger, Dental Health Statistician for the Ontario Department of Health has assisted Dr. Popovich and Dr. Hatton with the planning of the research, analysis of records, and preparation of reports.

The present status of the project has only been possible through the willingness of all members of the staff to contribute overtime work without compensation. This overtime has been mainly spent at the computations, clerical work, and the classification of records for which there is still no budget provision.

STAFF

The staff of the Ontario Research Center has remained

unchanged since last year's report with the exception of a few

changes in time.

Treatment is being conducted for a total of 24 days per week

by Dr. F. Popovich, M. Johnston, L. Scott, and R. Boyko. Records

(X-ray, histological and radiographic) are taken for a total of 24 days

per week by Dr. F. Popovich, M. Johnston, L. Scott, and R. Boyko. In addition

the clinical work, preparation of tissues and measurements have

been carried out by Dr. F. Popovich, M. Johnston, L. Scott, and R.

Boyko. Histological. Dr. Boyko has also conducted light studies

growth and development of the face. All processing of records

(X-ray, histological and radiographic) development of films, filling etc.,

has been carried out by Dr. F. Popovich, M. Johnston, L. Scott, and R.

Boyko. Dr. F. Popovich and Mrs. K. Scott.

Dr. F. Popovich and Mrs. K. Scott are the Ontario Department of

Health and assisted Dr. Popovich and Dr. Boyko with the planning of

research, analysis of records, and preparation of reports.

The present status of the project has only been possible

through the willingness of all members of the staff to contribute over-

and the willingness of all members of the staff to contribute over-

and the willingness of all members of the staff to contribute over-

and the willingness of all members of the staff to contribute over-

Level of Radiation Dosage to Staff and Patients.

As a result of the awareness in the dangers of radiation, enquiries were made at various times regarding the magnitude of the radiation exposure to the operator and patient during the taking of records.

The apparatus used for cephalometric radiography is of the high kilovoltage type (120 KV), with a target-subject distance of five feet, an aluminum filter at the tube of 2 mms thickness, a lead diaphragm of one-eighth inch thickness (the aperture being of sufficient size to limit the area covered by the useful beam to that of the film), and lead backed cassettes. All these factors tend to reduce the radiation hazard to a minimum.

By computation, and direct measurement with a radiation counter, the patient receives a total exposure of only 0.42 roentgens for a series of six cephalometric headplates and an additional exposure of 0.3 roentgens for a carpal radiograph. The areas radiated are confined to the head and hand respectively, radiation to other parts of the body being almost negligible. Our computations indicate that the gonadal radiation received during a full set of records adds less than 2% to the average annual gonadal dosage as computed by Glass.*

Even when considering that smaller areas are radiated during exposure of intra-oral dental films the relative amount of radiation received by the patient is considerably greater. Using 60 KV and 10 ma the average exposure time per film is three seconds (with standard non-screen dental film), and the patient receives approximately 22 roentgens exposure for a routine set of 14 films.

Efforts have also been made to protect the operator from radiation

*Glass, Bentley - "Radiation in Relation to Genetics"
Science, Aug. 1957.

exposure. He receives negligible radiation during exposure of cephalometric radiographs as he is protected by 5' x 7' lead screen. Some estimate of the total exposure received was obtained by using Film Badges worn by all operators during the last year. The Film Monitoring Service of the Department of National Health and Welfare reported that the total exposure to all operators was less than 0.020 roentgens per week.

Revision of the Number of Accumulated Treatment
Demonstration Records

In the last year the work on the serial group has progressed steadily and the number of records available at various ages is brought up to date in the revision below of Table II from the first report.

Table II (revised October, 1957.)
Age and Sex Distribution of Serial Group for Whom Annual Records
are on file and for whom necessary treatment is underway

Sex	<u>Age at Time Records were taken</u>						
	3yr.	4yr.*	5yr.	6yr.	7yr.	8yr.	9yr.
Males	134	163	160	133	70	1	-
Females	104	140	138	111	67	1	-
Total	238	303	298	244	137	2	-

* 65 four year olds were added to the initial group to ensure that the demonstration group would have more adequate numbers.

FINDINGS OF TREATMENT DEMONSTRATION.

Problem of Dissemination.

As a result of conducting the treatment for the serial group of children and the discussion of the treatment results at the monthly staff meetings the clinic staff have been, and are, learning much regarding the handling of the incipient malocclusion. This procedure will be continued as the serial group ages through the years to follow. However, the greater problem remains to be faced, i.e. the transfer of this knowledge from the staff to the practising dentists so that children living in areas outside the initial demonstration area may also benefit.

It is planned that at specific ages the diagnosis and treatment of many types of incipient malocclusion will be able to be set down and taught to graduating dentists so that they will be able to offer the service to all those desiring it. The residual of the malocclusions which are complex or which are accompanied by constitutional or congenital factors will of course remain the field of the orthodontic specialist but it is hoped that gradually the valuable few available specialists may be relieved of the treatment of the mass of simple routine cases by the general practitioners.

Classification of Malocclusion.

The diagnosis and treatment of malocclusion is a highly complex study. However, anatomically speaking, there are only a limited number of physical manifestations of malocclusion which occur at a specific age with any practical frequency. Thus the concept of the research group at Burlington is to classify all cases according to the physical defect or combination of defects present and to classify by specific ages the method of diagnosis and treatment recommended and demonstrated. Thus the report of the project will constitute an encyclopaedia on the diagnosis and treatment of malocclusion of any degree of complexity. To this end the following system of physical classification of malocclusion was evolved as a means of getting started and with the reservation that it will be subject to revision as new knowledge develops throughout the study. In its present form the classification has already done much to aid the careful planning of each child's individual treatment needs and to ensure that qualifying conditions such as loss of teeth or the presence of adenoids are taken into account.

The system of classification is such that the case is first sorted on its gross physical description and finally with reference to finer

It is planned that at present the diagnosis and treatment of many types of infectious diseases will be able to be set down as to the causative factors as they may be able to offer service to all those dealing with it. The treatment of the infectious diseases are complex or better are accompanied by constitutional or other factors will of course remain the field of the endocrinologist but it is hoped that gradually the various few available methods may be relieved of the treatment of the mass of simple cases by the general practitioners.

Classification of Malocclusion.

The diagnosis and treatment of malocclusion is a highly complex study. However, anatomically speaking, there are only a limited number of physical manifestations of malocclusion which occur as a result of any practical therapy. Thus the concept of the treatment of malocclusion is to classify all cases according to some physical test or combination of defects present and to classify by specific as the method of diagnosis and treatment recommended and determined. Thus the report of the project will constitute an orthodontic classification and treatment of malocclusion or any defect of occlusion. To this end the following system of physical classification of malocclusion was evolved as a means of easier study and with a reservation that it will be subject to revision as new knowledge develops throughout the study. In the present form the classification is already done much to aid the orthodontist in his study of individual treatment needs and to enable him to determine the type of case at hand on the grounds of occlusion and taken into account. The system of classification is now being used in the first year.

points which may modify treatment recommendations. The four groups of information are:

- I (AP) Anterior-posterior relation of dentures after Angle's method.
- II (P) Positional irregularities of individual teeth or groups of teeth within the alveolar processes.
- III(T) Defects of the teeth themselves which predispose to positional irregularities.
- IV(G) General conditions ranging from underlying facial development to presence of habits, or the co-operation of the child.

The order of classification is the conventional numerical order used in any index system with the provision that antero-posterior relationships must be recorded to be one of the alternatives N,D,D⁺, M, or M⁺, and n,d,d⁺,m, or m⁺. Other conditions if not present are not included in the individual case description. To clarify it should be understood that in the listing of conditions case N,PI, 5,T2, n would appear before case N,P3,T2, n; and N,PI, 5,T2,n, before D,PI, 5, T2, n,etc.

Preliminary Classification of Malocclusion

Description of Condition.

Code

Sex and Age

1 Antero-Posterior Denture Relation (cuspid, molar relation)

(N) Dental neutroccclusion

D) Dental distocclusion, end to end relation.

D+) Dental distocclusion, full cusp displacement.

M) Dental mesiocclusion, end to end relation.

M+) Dental mesiocclusion, full cusp displacement.

U) Unilateral

11 Position of Teeth

PI Anterior crossbite

P2 Posterior crossbite, buccal or lingual.

P3 Upper incisor overjet to lower incisor exceeding 3 mms.

P4 Lower incisor tip to upper incisor lingual exceeding zero.

P5 Overbite exceeding $\frac{1}{2}$ lower incisor crown.

P6 Openbite exceeding zero.

P7 Open contacts in lower permanent teeth exceeding 2.5 mms.

P8 Open contacts in upper permanent teeth exceeding 2.5 mms.

P9 Mid-line diastema in upper exceeding 2 mm.

Pl0 Simple malposition of one or more teeth to the extent of interfering with function but where there is room for correction, eg. rotation.

Pl1 Crowding out of position of one or more teeth and where space would have to be made for correction.

III Tooth Defects Influencing Occlusion.

T1 Premature loss of one or more deciduous teeth, where spacer

T2 Loss of one or more permanent teeth. needed.

T3 One or more congenitally missing teeth.

T4 One or more supernumerary teeth.

T5 One or more malformed teeth.

T6 Macrodontia,

T7 Submersion, or over-retention of one or more deciduous teeth.

T8 Ectopic-eruption, or impaction of one or more teeth.

T9 Uncontrolled dental caries likely to cause serious tooth loss.

IV Associated or General Conditions

n) Skeletal neutroccclusion, B point to A plane, +3 to - 1mm.

d) Skeletal distocclusion, B point to A plane, -1 to - 2mms.

d+) Skeletal distocclusion, B point to A plane, -2 or more neg.

m) Skeletal mesiocclusion, B point to A plane, +3 to 4 mms.

m+) Skeletal mesiocclusion, B point to A plane, +4 mms. or more.

1 Abnormal narrow arches and /or high palate,

2 Congenital cleft palate and /or hare lip.

3 Nasal or pharyngeal defect or obstruction, adenoids etc.

4 Endocrine or other general constitutional defect.

5 Behaviour problem.

6 Sucking habit, if active 6a.

7 Facial asymmetry.

Example: Male 8D, P3, T2, 9, n5, 6. An eight year old boy with moderate (end to end) dental distocclusion, excessive overjet, lost permanent teeth and caries still uncontrolled, an unco-operative patient with a history of sucking habit.

Final Classification of Malocclusion

Classification of Conditions

General Positioning (tooth, jaw relation)

- 1) General malocclusion
- 2) General malocclusion, and no jaw relation
- 3) General malocclusion, full jaw displacement
- 4) General malocclusion, and no jaw relation
- 5) General malocclusion, full jaw displacement
- 6) Unilateral

Position of Teeth

- 7) Anterior protrusion
- 8) Protrusion of maxilla, tooth or lingual
- 9) Upper incisor protruding to lower incisor exceeding 3 mm.
- 10) Lower incisor protruding to upper incisor exceeding 3 mm.
- 11) Overbite exceeding 4 lower incisor crown
- 12) Overbite exceeding 4 mm.
- 13) Open contact in lower permanent teeth exceeding 3.5 mm.
- 14) Open contact in upper permanent teeth exceeding 3.5 mm.
- 15) Malocclusion in upper exceeding 3 mm.
- 16) Right malocclusion of one or more teeth in the extent of later-
forming with function and where there is room for correction,
as indicated.
- 17) Crowding or position of one or more teeth and where space
would have to be used for correction.

Other Malocclusion Conditions

- 18) Protrusion of one or more deciduous teeth, where space
needed.
- 19) Loss of one or more permanent teeth
- 20) One or more congenitally missing teeth
- 21) One or more supernumerary teeth
- 22) One or more retained teeth
- 23) Malocclusion
- 24) Malocclusion, an over-retention of one or more deciduous teeth
- 25) Malocclusion, or retention of one or more teeth
- 26) Uncontrolled dental caries likely to cause serious tooth loss

Associated or Secondary Conditions

- 27) General malocclusion, 2 points or 4 mm, 4 to 6 mm
- 28) General malocclusion, 2 points or 4 mm, 6 to 8 mm
- 29) General malocclusion, 2 points or 4 mm, 8 to 10 mm
- 30) General malocclusion, 2 points or 4 mm, 10 to 12 mm
- 31) General malocclusion, 2 points or 4 mm, 12 to 14 mm
- 32) General malocclusion, 2 points or 4 mm, 14 to 16 mm
- 33) General malocclusion, 2 points or 4 mm, 16 to 18 mm
- 34) General malocclusion, 2 points or 4 mm, 18 to 20 mm
- 35) General malocclusion, 2 points or 4 mm, 20 to 22 mm
- 36) General malocclusion, 2 points or 4 mm, 22 to 24 mm
- 37) General malocclusion, 2 points or 4 mm, 24 to 26 mm
- 38) General malocclusion, 2 points or 4 mm, 26 to 28 mm
- 39) General malocclusion, 2 points or 4 mm, 28 to 30 mm
- 40) General malocclusion, 2 points or 4 mm, 30 to 32 mm
- 41) General malocclusion, 2 points or 4 mm, 32 to 34 mm
- 42) General malocclusion, 2 points or 4 mm, 34 to 36 mm
- 43) General malocclusion, 2 points or 4 mm, 36 to 38 mm
- 44) General malocclusion, 2 points or 4 mm, 38 to 40 mm
- 45) General malocclusion, 2 points or 4 mm, 40 to 42 mm
- 46) General malocclusion, 2 points or 4 mm, 42 to 44 mm
- 47) General malocclusion, 2 points or 4 mm, 44 to 46 mm
- 48) General malocclusion, 2 points or 4 mm, 46 to 48 mm
- 49) General malocclusion, 2 points or 4 mm, 48 to 50 mm
- 50) General malocclusion, 2 points or 4 mm, 50 to 52 mm
- 51) General malocclusion, 2 points or 4 mm, 52 to 54 mm
- 52) General malocclusion, 2 points or 4 mm, 54 to 56 mm
- 53) General malocclusion, 2 points or 4 mm, 56 to 58 mm
- 54) General malocclusion, 2 points or 4 mm, 58 to 60 mm
- 55) General malocclusion, 2 points or 4 mm, 60 to 62 mm
- 56) General malocclusion, 2 points or 4 mm, 62 to 64 mm
- 57) General malocclusion, 2 points or 4 mm, 64 to 66 mm
- 58) General malocclusion, 2 points or 4 mm, 66 to 68 mm
- 59) General malocclusion, 2 points or 4 mm, 68 to 70 mm
- 60) General malocclusion, 2 points or 4 mm, 70 to 72 mm
- 61) General malocclusion, 2 points or 4 mm, 72 to 74 mm
- 62) General malocclusion, 2 points or 4 mm, 74 to 76 mm
- 63) General malocclusion, 2 points or 4 mm, 76 to 78 mm
- 64) General malocclusion, 2 points or 4 mm, 78 to 80 mm
- 65) General malocclusion, 2 points or 4 mm, 80 to 82 mm
- 66) General malocclusion, 2 points or 4 mm, 82 to 84 mm
- 67) General malocclusion, 2 points or 4 mm, 84 to 86 mm
- 68) General malocclusion, 2 points or 4 mm, 86 to 88 mm
- 69) General malocclusion, 2 points or 4 mm, 88 to 90 mm
- 70) General malocclusion, 2 points or 4 mm, 90 to 92 mm
- 71) General malocclusion, 2 points or 4 mm, 92 to 94 mm
- 72) General malocclusion, 2 points or 4 mm, 94 to 96 mm
- 73) General malocclusion, 2 points or 4 mm, 96 to 98 mm
- 74) General malocclusion, 2 points or 4 mm, 98 to 100 mm

Malocclusion is a condition of the teeth and jaws which is not in harmony with the normal functional relationship of the teeth and jaws.

Frequencies and Treatment Results.

In the following sections a preliminary classification of the serial group and of the age 6 years control group has been attempted. From these tabulations it is clear that although the theoretical number of combinations of the approximate two dozen defects is astronomical the actual number of different classifications of malocclusion was only 22 at age three, 34 at age four, 40 at age five, and 42 at age six for serials and 110 for age six controls. This constitutes a very real simplification of the problem of recommending and teaching case management. The progress of each case is possible by tracing the serial number through the various ages, as an example see case #416 on page 11. Conclusions regarding treatments finally recommended by the committee will of course be eventually inserted at each age in the place where the treatment demonstrations are now listed.

Page 13 is an example of the form used to classify cases. One copy is preserved in the records for each child and a carbon copy is used to facilitate the sorting of results for preparation of tables such as pages 9 to 12. To date only about one third of the serial group has been classified but these partial results are released to illustrate the method of the study.

Value of Interceptive Treatment.

Group I and II defects compose the actual malocclusion manifestations while Group III and IV conditions are predisposing or complications of a general nature influencing prognosis. It may be seen from page 9 that almost 20 percent of the control group were reported to have only Group III defects. These are not preventable with the exception of a portion of the dental caries, but the resulting malocclusions seem likely to be intercepted if the appropriate steps are taken before

CLASSIFICATION AND TREATMENT OF CASES, (Incomplete Listing)

Classification A-P, P, T, G	3 Years Serial No.	4 Years Serial No.	5 Years Serial No.	6 Years Serial No.	6 Yr. Control No. %
Nn	117,135,162, 164,191,257, 256,274,278, 283,313,334, 334,381,465, 470,595,606, 636,657,664, 723,736.	108,117,135, 162,164,191, 252,256,274, 278,283,313, 334,336,381, 465,470,595, 606,634,636, 657,664,736,	108,114,117, 135,145,162, 164,191,252, 256,274,283, 313,334,336, 381,465,595, 606,634,636, 657,723,736, 889.	108,117,135, 164,191,256, 274,283,313, 336,381,392, 510,595,606, 634,636,723, 736,723,889,	65 22.5
Nd	-	-	-	-	6 2.1
Nm	-	-	-	-	1 .3
Nn3	114,107,392,	107,114,392,	107,392	107,114	7 2.3
Nn3,6	-	-	-	-	1 .3
Nn3,6a	-	-	-	-	1 .3
Nn6	188	188	627	637,640	9 3.1
Nn6a	144,244	244,627,640	244,640	296	12 4.2
				Sub. Total	12.6%
NT1n	-	25	25 regainer 278 spacer 470	25 regainer Spacers 278 465,470.	10 3.5
NT1n6	-	-	-	616	1 .3
NT1n6a	-	-	616	-	1 .3
NT1d	-	-	-	-	1 .3
NT1,3n3	-	-	-	483 spacer	- -
NT1,4n	-	483	-	-	- -
NT1,6n	-	-	-	-	1 .3
NT1,9n	-	-	-	-	7 2.3
NT1,9n6	-	-	-	-	2 .6
NT1,9n6a	-	-	-	-	2 .6
NT1,9d	-	-	-	-	1 .3
NT3n	-	-	-	-	2 .6
NT3n3	-	-	-	-	2 .6
NT3n6	-	-	-	-	1 .3
NT3d	-	-	-	-	1 .3
NT3d6a	-	-	-	-	1 .3
NT3,4n	-	-	483 regainer	-	- -
NT3,6n	-	-	-	-	2 .6
NT4n	-	-	-	-	1 .3
NT5n6	-	-	-	-	1 .3
NT5,6n	-	-	-	-	1 .3
NT6n	-	-	-	252,657	10 3.5
NT6n3	-	-	-	-	2 .6
NT6n6	-	-	-	-	2 .6
NT6n6a	-	-	-	144	2 .6
NT6d6a	-	-	-	-	1 .3
NT9n	-	-	-	162	3 1.0
				Sub. Total	19.8%
NP1n	-	-	-	-	1 .3
NP1n3,6	-	-	-	-	1 .3
NP1,4T1,3n3	-	-	-	-	- -
NP2n	198,478	198,478,510	198 inc.pln. 478 510 lin. arch	198 inc.pln 478 lin. arch	4 1.4

CLASSIFICATION AND TREATMENT OF CASES, (incomplete Listing).

Classification A-P, P, T, G	3 Years Serial No.	4 Years Serial No.	5 Years Serial No.	6 Years Serial No.	6 Yr. Control No. %
NP2n6a	-	-	-	-	2 .6
NP2T1n1	-	137	-	-	- -
NP2,3,4T6,9n3	-	-	-	-	1 .3
Np2,3,4,5T3n	-	-	-	-	1 .3
NP2,6n6a	545	545 lin.arch	-	-	- -
NP2,6T1n	-	-	137	137 exercise lin. arch & plate ret'r	- -
NP2,9n6	-	-	-	-	1 .3
NP3n	108,180	180	180,861	180	1 .3
NP3n3	861	861	-	-	- -
NP3n6a	296	296	296	-	- -
NP3d	-	-	-	-	1 .3
NP3T1n	-	-	-	-	1 .3
NP3,4n	-	-	-	-	4 1.4
NP3,4n3,6	133	-	-	-	- -
NP3,4n6	-	133	-	641	2 .6
NP3,4n6a	319,602,616 627,640	144,602,616	144,602,641	-	4 1.4
NP3,4T1n6a	-	-	-	-	1 .3
NP3,4T1,6n	-	-	-	-	1 .3
NP3,4T1,9d	-	-	-	-	1 .3
NP3,4T3n6	-	-	-	602 Hawley	- -
NP3,4,5n	-	-	-	-	1 .3
NP3,4,5T1n	368	-	-	-	- -
NP3,4,6d6a	-	-	-	-	1 .3
NP3,4,9n	-	-	-	-	1 .3
NP3,4,9T1n3,6a	-	-	-	-	1 .3
NP3,5n	-	-	-	-	2 .6
NP3,5n3	-	-	-	217	- -
NP3,5T1n	-	368	368	368	- -
NP3,6n6a	139,387	387	-	-	- -
NP3,9n6a	-	-	-	-	1 .3
NP3,10d	-	-	-	-	1 .3
NP4n6	-	-	133	133	- -
NP5n	145,169,492	145,169,304 466,492,498	217,304,332 466	304,332	8 2.8
NP5n3	-	217,332	-	-	- -
NP5n6a	537	121,537	537	-	- -
NP5d	-	-	-	466	5 1.7
NP5T1n	261	261	261	261	1 .3
NP5T3,6n	-	-	-	-	1 .3
NP5T6n	-	-	-	-	1 .3
NP5,10n	-	-	-	-	1 .3
NP6n	-	-	-	-	1 .3
NP6n6a	-	-	545 lin.arch mono,	-	- -
NP6T1,9d6a	-	-	-	-	1 .3
NPT3n6a	-	-	387	387	- -
NP9n	-	-	169	169	5 1.7
NP9n6a	-	-	-	-	1 .3
NP9T7n	-	-	-	-	1 .3
NP10n	-	-	-	-	1 .3
NP10n6a	-	-	-	-	8 2.8
Sub Total.....					24.3%

CLASSIFICATION AND TREATMENT OF CASES, (Incomplete Listing)

6 yr.

Classification A-P,P,T,G.	3 Years Serial No.	4 Years Serial No.	5 Years Serial No.	6 Years Serial No.	Control No.	%
Dn	-	257	257 Grind	257	6	2.1
Dn6	-	-	-	-	1	.3
Dn1,6	-	-	-	416 lin arch mono.	-	-
Dn3,6	-	-	289 exer. Bite p. mono.	289 mono. as ret.	-	-
Dd	-	-	-	-	4	1.4
Dd6	-	-	188	121 mono	1	.3
Dd6a	-	-	-	-	2	.6
DT1,6,9d6a	-	-	-	-	1	.3
DT1,9d	-	-	-	-	1	.3
DT1,9d3,5	-	-	-	863	-	-
DT5n3,6a	-	-	-	-	-	-
DT3,4,5d6a	-	-	-	-	1	.3
DT6d	-	-	-	706 Serial	-	-
DT6d6	-	-	-	188	-	-
DT7n6	-	-	-	545 new mono	-	-
DT9d	-	-	-	-	1	.3
				Sub. Total		6.3%
DP1d	-	-	-	-	1	.3
DP1T1n6a	-	-	-	-	1	.3
DP2d6a	-	-	-	-	1	.3
DP2,3,4d1,6a	416	416 lin. arch	-	-	-	-
DP2,3,4d6a	-	-	-	-	1	.3
DP2,3,4,5,d	-	-	-	-	1	.3
DP3d3	-	-	-	-	1	.3
DP3,4n	-	-	-	-	1	.3
DP3,4n3,6a	289	289 grind. exer. Hawley, Mono	-	-	-	-
DP3,4n1,6a	-	-	416 lin.arch	mono-	-	-
DP3,4n6a	375	375	245,375 Cal.	-	-	-
DP3,4d	-	-	-	-	2	.6
DP3,4d3	863	-	-	-	-	-
DP3,4d3,6	-	-	-	131	-	-
DP3,4d3,6a	717	131	131	-	-	-
DP3,4d6	-	-	319	319,375,- 717 Hawley	-	-
DP3,4d6a	-	319,245,- 717 Hawley	717 Hawley	-	2	.6
DP3,4T1d	-	-	-	-	1	.3
DP3,4T1d6	-	-	-	-	1	.3
DP3,4T1,9n	-	-	-	-	1	.3
DP3,4T1,9d3,5	-	-	863 Mono.	-	-	-
DP3,4T6n6	-	-	-	245 Mono.Ser.	-	-
DP3,4T6d	-	-	-	-	1	.3
DP3,4T9d3	-	863	-	-	-	-
DP3,4,5d	-	-	-	-	1	.3
DP3,4,5d6	-	-	266 Mono. & Hawley	-	-	-
				266 Contin.	1	.3
DP3,4,5d6a	266	266 Hawley	-	-	1	.3
DP3,4,5T1n	-	-	-	-	1	.3
DP3,4,6n6a	-	287	-	-	1	.3

CLASSIFICATION AND TREATMENT OF CASES. (Incomplete Listing).

Classification A-P, P, T, G	3 Years Serial No.	4 Years Serial No.	5 Years Serial No.	6 Years Serial No.	6 Yr. Control	
					No.	%
DP3,4,6T9d6a	-	-	-	287	-	-
DP3,4,6T5,6,9d6a	-	-	287	-	-	-
DP3,4,9d6	-	-	893 Hawley	-	-	-
DP3,4,9d6a	152,893	152,	152 Hawley	-	-	-
		893 Hawley	Mono			
DP3,5d	-	706 Hawley & L.Expan. P.	706 Contin.	-	1	.3
DP3,5d3	706	-	-	-	-	-
DP3,5d3,6	-	716	716	716	-	-
DP3,5d3,6a	716	-	-	-	-	-
DP3,6d3,6a	-	953	953	953 Cal.Mono	-	-
DP3,9n	-	-	-	-	1	.3
DP4n6a	-	-	-	-	1	.3
DP5n	-	-	492	492	-	-
DP5d	-	-	498 Grind	498 Mono	3	1.0
			590			
DP5n3	-	570	-	-	-	-
DP5d6	-	-	-	-	1	.3
DP5d6a	121	-	121	-	1	.3
DP5,9d	-	-	-	590	-	-
DP6d6	-	-	-	-	1	.3
DP9d6	-	-	-	152 Mono	-	-
				Sub. Total	10.1%	
Mn	-	-	-	-	1	.3
Mm	-	-	-	-	2	.6
MT1m6a	-	-	-	-	1	.3
MT1,7n	-	-	-	-	1	.3
MT1,9n	-	-	-	-	1	.3
MP1T1,3m	-	-	-	-	1	.3
MP1n3,6a	-	-	-	-	1	.3
MP2n6a	-	-	-	-	1	.3
MP2,9T1,5,6m6a	-	-	-	-	1	.3
MP6T9m	-	-	-	-	1	.3
				Sub. Total	3.8%	

ORTHODONTIC RESEARCH CLASSIFICATION

Circle correct code number

CASE NO.	AGE SEX	CLASSIFICATION				TREATMENT	TIME		RESULTS or REMARKS
		DENTURE RELAT'N	TOOTH POSITION	TOOTH DEFECTS	GENERAL		MONTHS	CHAIR	
3 or 9	N D D+	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d+ 2 d+ 3					
M or F	M M+ U	4 10 5 11 6	4 5	m 4 m+ 5 6a 7					
4 or 10	N D D+	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d 2 d+ 3					
M or F	M M+ U	4 10 5 11 6	4 5 6	m 4 m+ 5 6a 7					
5 or 11	N D D+	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d 2 d+ 3					
M or F	M M+ U	4 10 5 11 6	4 5 6	m 4 M+ 5 6a 7					
6 or 12	N D D+	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d 2 d+ 3					
M or F	M M+ U	4 10 5 11 6	4 5 6	m 4 m+ 5 6a 7					
7 or 13	N D D+	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d 2 d+ 3					
M or F	M M+ U	4 10 5 11 6	4 5 6	m 4 m+ 5 6a 7					
8 or 14	N D D	1 7 2 8 3 9	1 7 2 8 3 9	n 1 d 2 d+ 3					
M or F	M M U	4 10 5 11 6	4 5 6	m 4 m+ 5 6a 7					

complications occur.

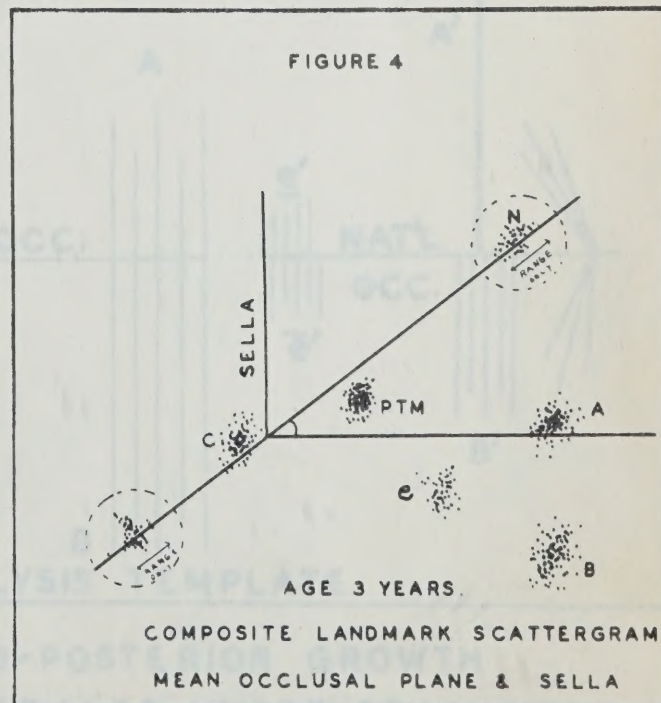
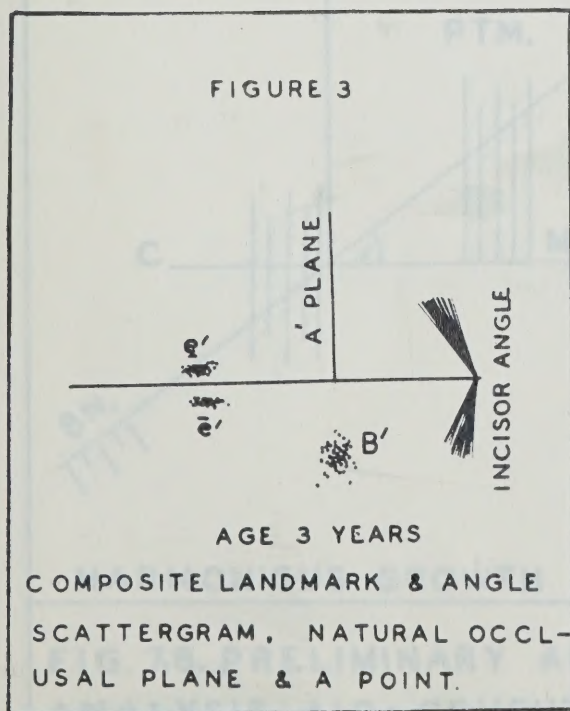
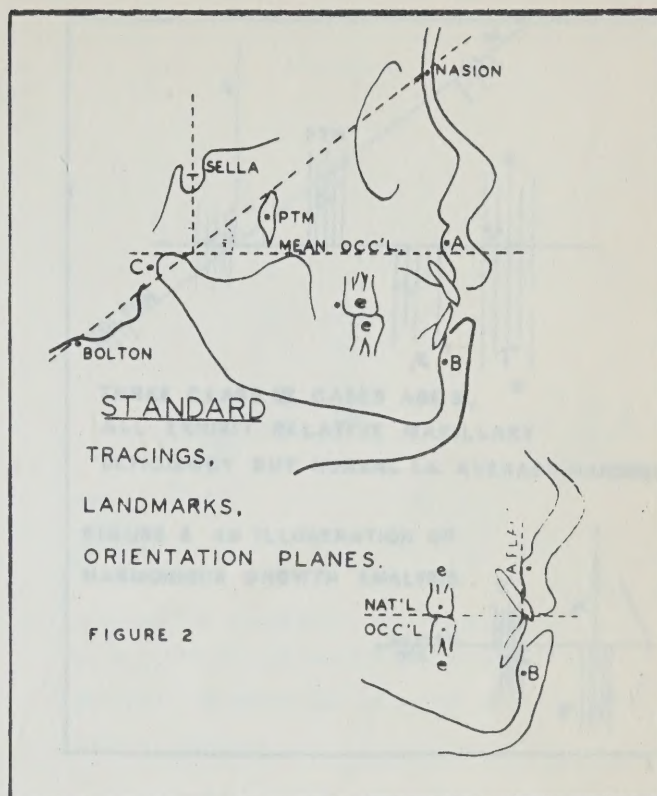
Group IV conditions also may not be preventable but their complications seem to be avoidable if the conditions are recognized early and the appropriate steps taken. Thus for example a child who is mouth breathing may have had his adenoids removed before any manifestations of malocclusion appear. And again a child with a sucking habit may be encouraged to stop (perhaps by the calendar method) before true tooth displacement has resulted.

It is too early to make a statement as to how many true Group I or Group II defects are going to be prevented at each age by the institution of early treatment but it appears likely that many gross conditions such as crossbites, and crowded arches due to teeth drifting after premature tooth loss will soon disappear from the active treatment list. Also many of the distocclusions for the 6 year age group are nearing resolution so that by age 7 or 8 it is felt there will be a striking contrast to the frequencies recorded for the controls. It is most revealing to report at this stage that in the whole 6 year control group only one child was found to be under treatment by his private dentist out of the 186 or (64%) having malocclusion.

With regard to the place of the general practitioner in this field it is becoming clear that a rather high percentage of the cases are of a fairly simple nature and it should be possible to teach the treatment of these simple cases at the undergraduate level, providing, enough time is made available in future dental faculty curriculums. Essential to such teaching will be the clarity with which classification can be carried out. The present classification is still crude but will be progressively refined as the basic research continues.

Research in Diagnostic Methods.

The scope of this part of the Burlington project is virtually unlimited and it is expected to continue for a long time after the active stage of collecting data is finished. Many refinements are needed in the methods of determining the proper status for an individual in the classification system given on page 7 of this report. The staff are aware of the difficulties in defining, for example, such conditions as macrodontia, or determining the underlying antero-posterior relationship of the individual. Much work has been done and is planned in this aspect of the problem and some success has already been achieved as demonstrated in figures 1 to 14, which deal with the problem of assessing defects in antero-posterior facial development. The potential physical growth as determined genetically is modified by a host of environmental influences, hence, it is not surprising that facial "balance" and asymmetry are frequently not acceptable. It is necessary however to be able to assess how much variation of size and shape within the components of the face of one individual are compatible with the development of normal occlusion. With this end in view the distribution of certain key-landmarks have been plotted for individuals having normal occlusion. Abnormal facial development is judged as being disproportionate development, see figures 1 to 8. Thus in figure 6, the three mesiocclusion cases illustrated were shown to have mandibles that are in the upper quartile of the distribution of size but maxillae that are in the lower end of the size range. This antero-posterior discrepancy in basal bone is sufficient to prevent the correct tooth interdigitation and the resulting malocclusion cannot be ideally corrected until at least a portion of the skeletal disharmony is also corrected. Figures 9 to 14 illustrate an experimental method of assessing antero-posterior growth, expressing the growth of the components in terms



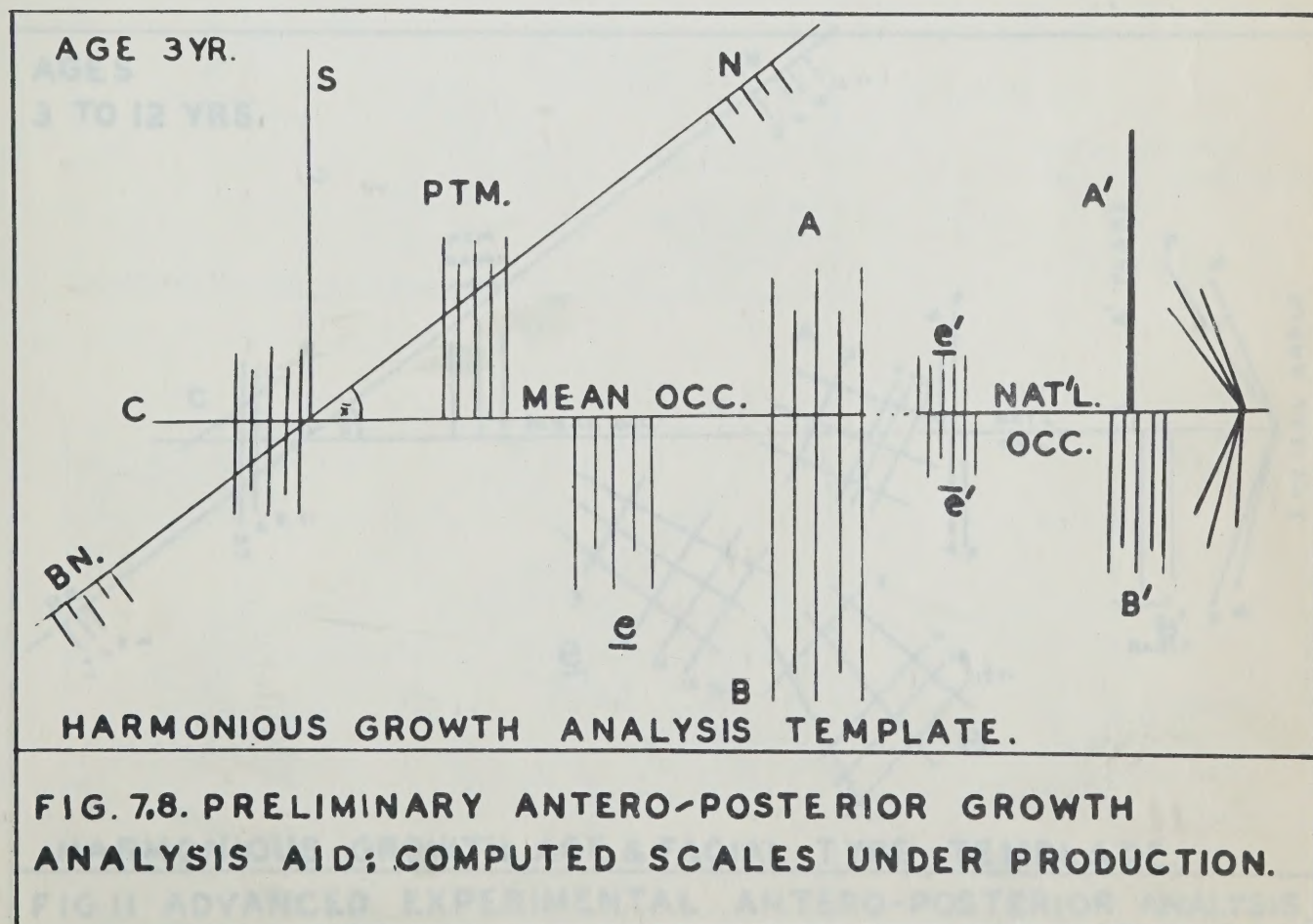
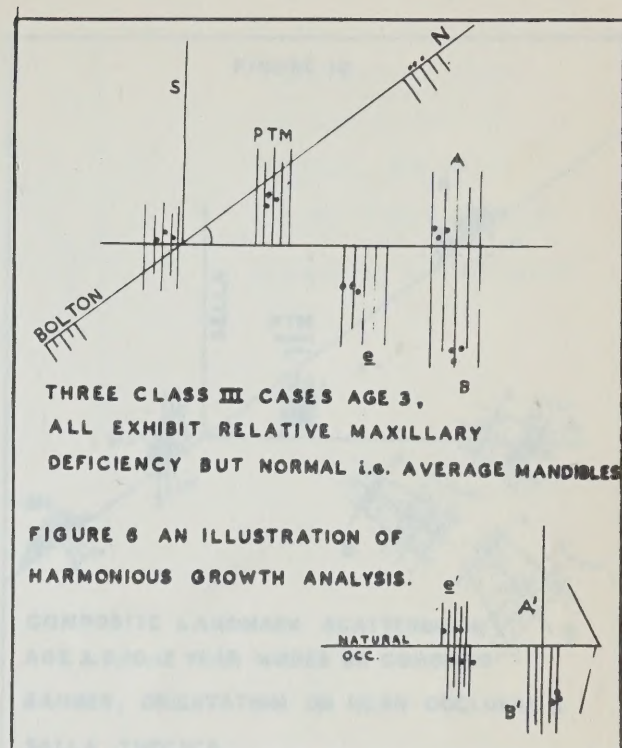
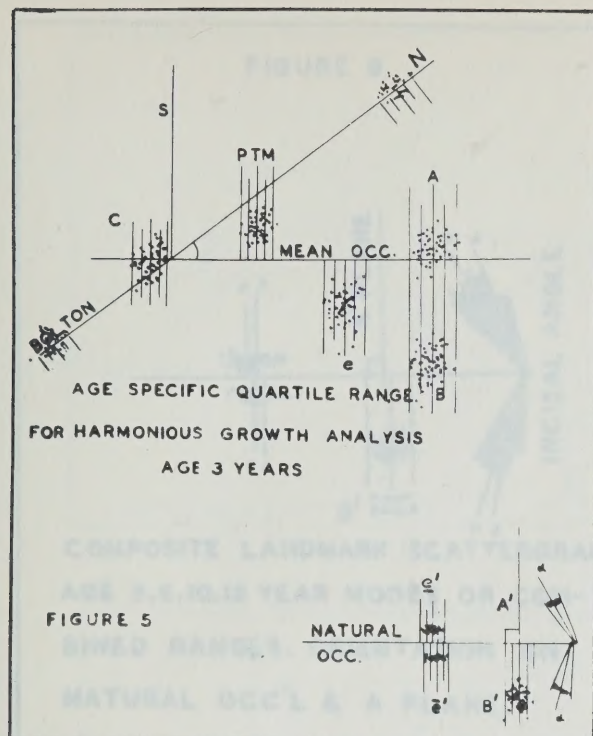
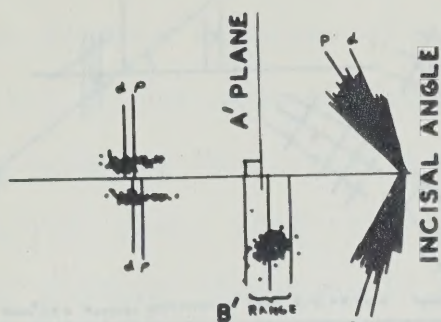
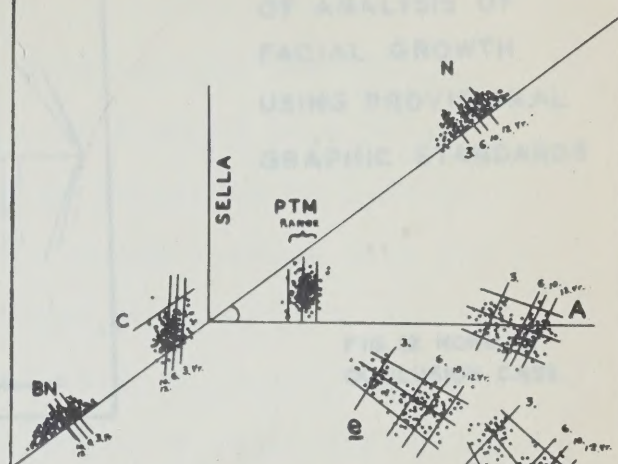


FIGURE 9



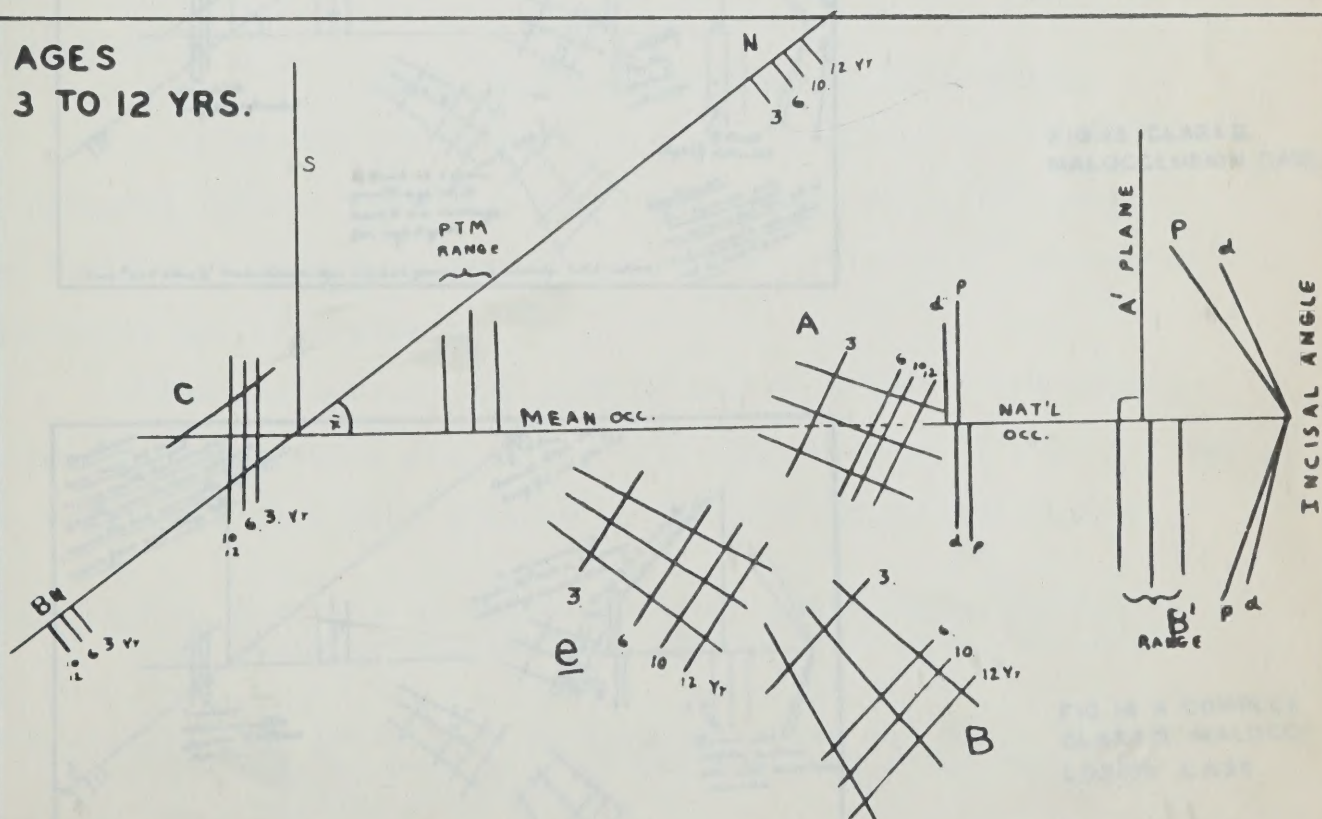
COMPOSITE LANDMARK SCATTERGRAM,
AGE 3,6,10,12 YEAR MODES OR COM-
BINED RANGES. ORIENTATION ON
NATURAL OCC'L & A PLANE.

FIGURE 10



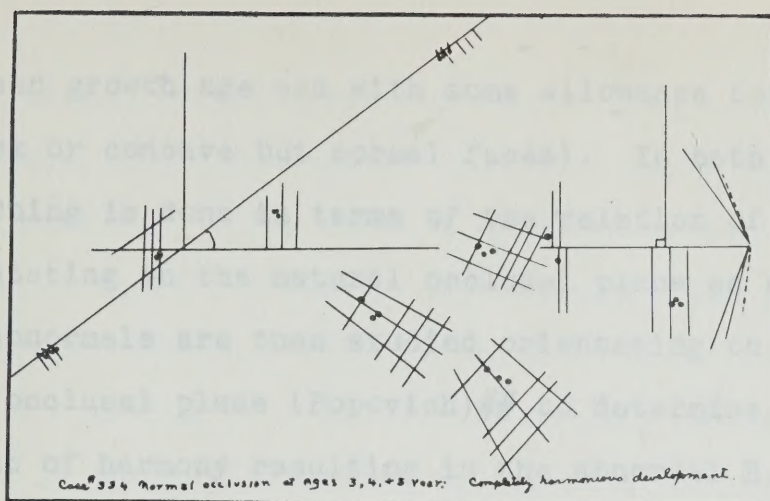
COMPOSITE LANDMARK SCATTERGRAM,
AGE 3,6,10,12 YEAR MODES OR COMBINED
RANGES. ORIENTATION ON MEAN OCCLUSAL &
SELLA TURCICA.

AGES
3 TO 12 YRS.



HARMONIOUS GROWTH AGE & FACIAL TYPE TEMPLATE.

FIG. II ADVANCED EXPERIMENTAL ANTERO-POSTERIOR ANALYSIS.



ILLUSTRATIONS OF ANALYSIS OF FACIAL GROWTH USING PROVISIONAL GRAPHIC STANDARDS

FIG. 12 NORMAL
OCCLUSION CASE.

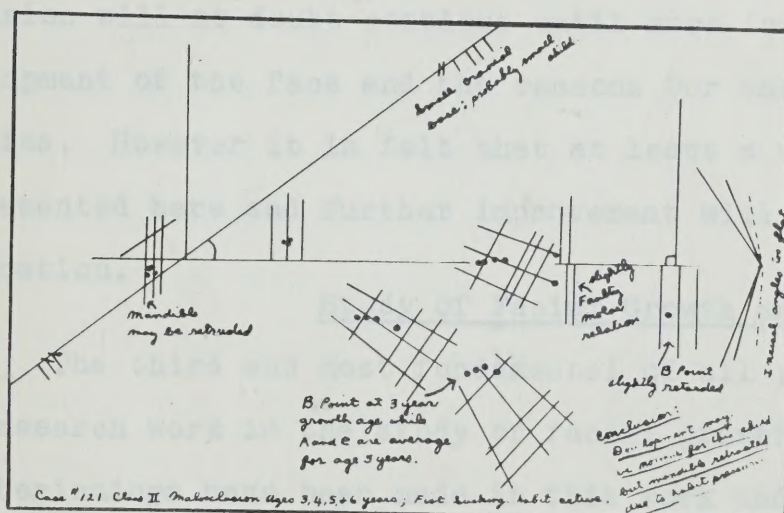


FIG. 13 CLASS II
MALOCCLUSION CASE.

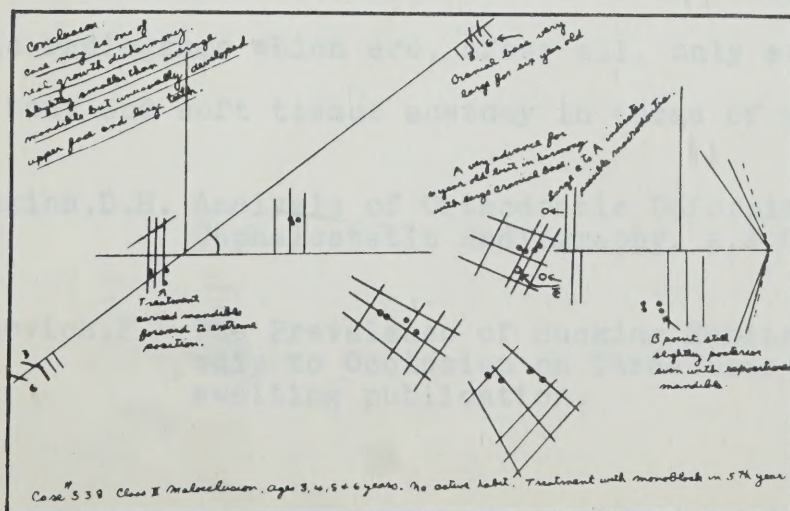


FIG. 14 A COMPLEX
CLASS II MALOC-
CLUSION CASE.

of mean growth age and with some allowance for facial type (i.e. convex or concave but normal faces). In both systems the initial screening is done in terms of the relation of B point to A point orientating on the natural occlusal plane as suggested by Jenkins #. The abnormals are then studied orientating on the cranial base and a mean occlusal plane (Popovich)## to determine what part of the face is out of harmony resulting in the abnormal B.to A. relation.

This work of refining the classification or diagnosis of mal-occlusion will no doubt continue until more is known concerning the development of the face and the reasons for the occurrence of irregularities. However it is felt that at least a workable classification is presented here and further improvement will come by experience in application.

Study of Facial Growth and Development

The third and most fundamental of all phases of the Burlington research work is the study of facial growth and development. Some beginnings have been made in this work and it will proceed as opportunity and time permits.

Primarily a study was made of the accuracy of the cephalometric radiograms which are, after all, only a means of studying the true bony and soft tissue anatomy in terms of projected shadows.

#

Jenkins,D.H. Analysis of Orthodontic Deformity Employing Lateral Cephalostatic Radiography. A.J.O.Vol.41,June,1955.

##

Popovich,F. The Prevalence of Sucking Habits and their Relationship to Occlusion on Three Year Old Children - awaiting publication.

Because of the nature of the technique of cephalometric radiography, the measurements fail to exactly duplicate the true bony dimensions. The first source of variation is due to an inherent average magnification of approximately ten percent for the lateral head plates, (subject, film distance 15 cms) and slightly less for the oblique plates (subject, film distance 14 cms), depending on the distance of the anatomical dimension from the mid-plane of the skull. Also measurements taken from the PA film have varying degrees of magnification depending on the distance of the bony landmarks from the film, the cassette being in contact with the nose. Thus it must be recognized that measurements obtained from different types of cephalograms are not exactly interchangeable and all differ somewhat from direct measurements, (e.g. from models).

Secondly, the measurements are subject to more or less random technical error due to placement of the child in the head-positioner and the mechanics of producing tracings^X and measurements. This problem has been previously introduced as study No. 3 and page 31 of the first report. In the last year additional work has been done as a continuation of this study and the work will be reported in detail in a subsequent report. In summary it was found that the greatest source of variation is generally the difference between children and from the viewpoint of experimental design the greatest reliability of estimates is provided by large numbers of children rather than by further refinement of the present cephalometric methods.

X mid-plane technique is employed in tracing bilateral landmarks in lateral cephalograms

The work on the diagnosis of antero-posterior facial development reported on pages 18 and 19 also constitutes research into growth and development of the face and is not reported to avoid repetition under this heading. Much work has also been carried out on the genetic or hereditary position of the teeth and thus the predisposing influence of heredity on tooth eruption and malocclusion. A beginning has been made on the collection of records from the parents of the children who make up the serial study group and this supplementary data will no doubt prove to be of much value.

Some Factors Governing Clinical Eruption

(continuing Study No.4 page 34 Report Series 1)

by

Margaret E.Hatton

Introduction

The possible significance of eruption of the teeth to the growth and development of the masticatory apparatus has been considered by several investigators. 1,2,3,4,5,6. The Burlington Data provides an unusual opportunity for further clarification of this relation by means of the series of cephalometric radiograms. The children making up the serial sample have been seen at ages 3,4,5, and 6 years and recordings of the eruption of the lower permanent molars have been made at each age. Broadbent's⁶ work, and that of Carlson's⁷ make it clear that roentgenographic cephalometry is a valuable technique in understanding the eruptive behaviour of the teeth.

The complexity of the process of eruption becomes readily apparent when one considers that sex, race, geographic distribution, climate, social level and economic well being have some effect, quite apart from the more basic influence of hereditary factors. Thus the present study is an attempt to analyse only four features within the complex of tooth growth and development during the intra-alveolar and up to the intra-oral stage of eruption (Fig.1.)

Figure 1

Two developmental stages of eruption
included in the study
I, II, III. intra-alveolar
IV intra-oral

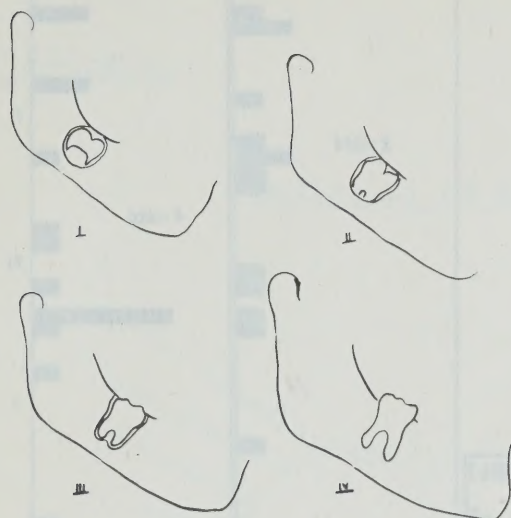
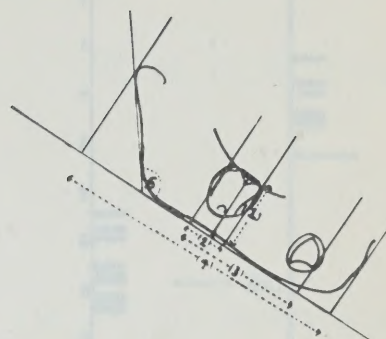


Figure 3

Measurements made from
tracings of oblique cephalograms



- 1 molar height
- 2 tooth size
- 3 mesio-distal measurement
- 4 length of the mandible
- 5 gonial angle

Relation between Mesio-distal Width of $\overline{66}$ at 36 mos.
and Intra-oral Eruption at 72 mos. in 40 males

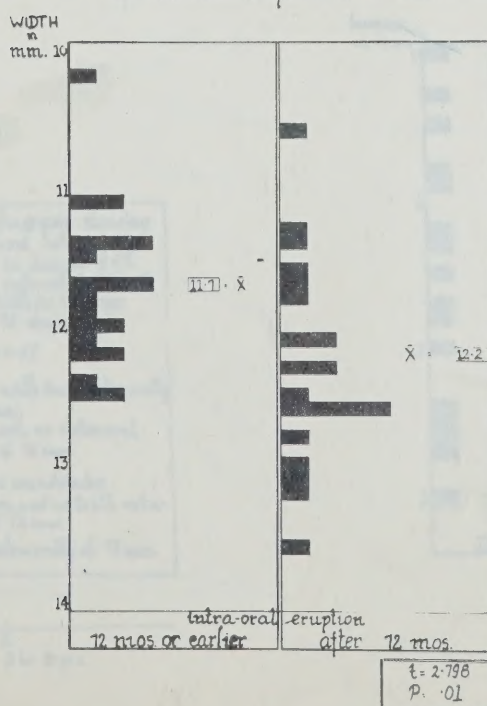


Figure 4

Relation between Height of 66 above the Inferior Border of the mandible at 3 years and Intra-oral Eruption at 72 mos. in 34 males.

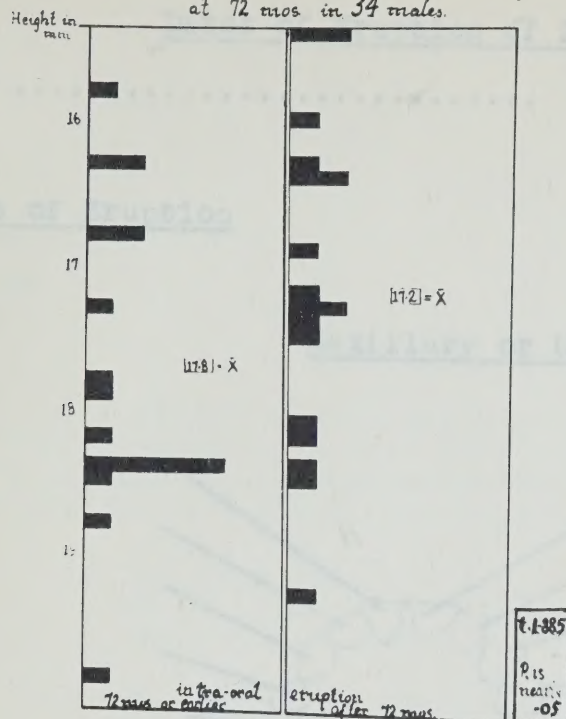


Figure 5

Relation between Increase in Height above the inferior Border of the Mandible of 66 between 3-6 years and Intra-oral eruption at 72 mos. in 20 males.

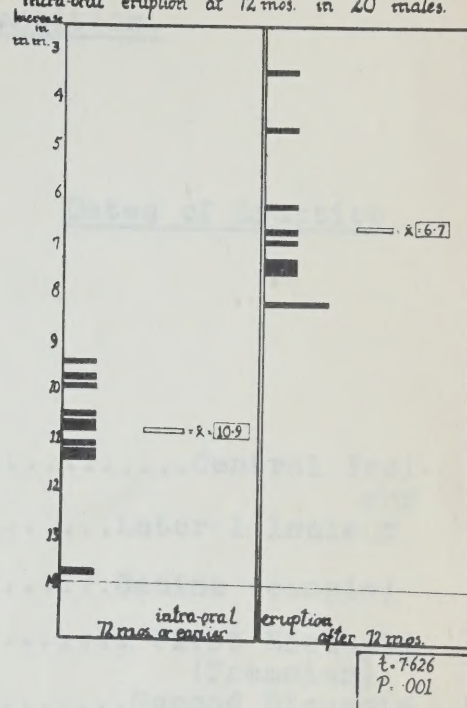


Figure 6

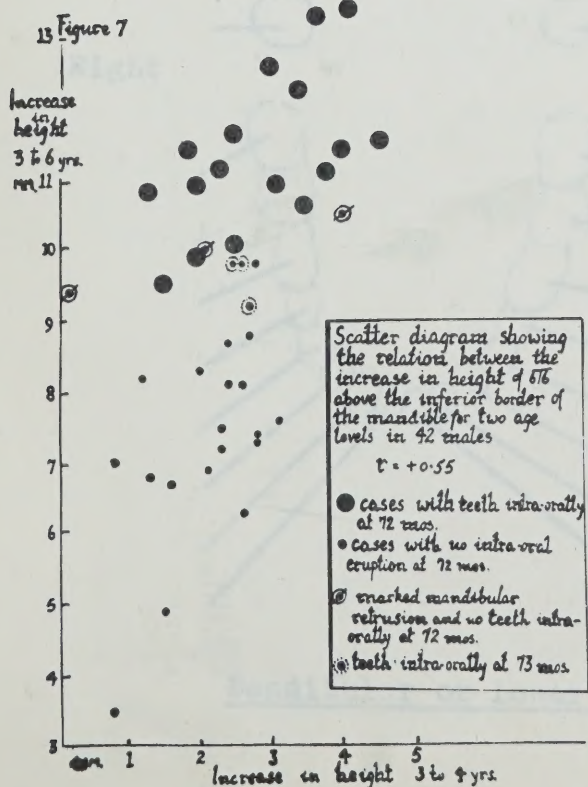


Figure 7

Relation between Increase in Arch Width posterior to 66 between 3-6 years and intra-oral Eruption of 66 at 72 mos. in 30 males.

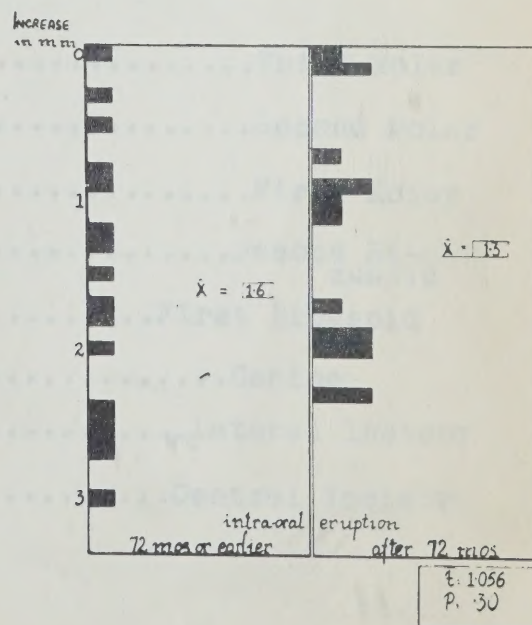


Figure 8

Figure 2

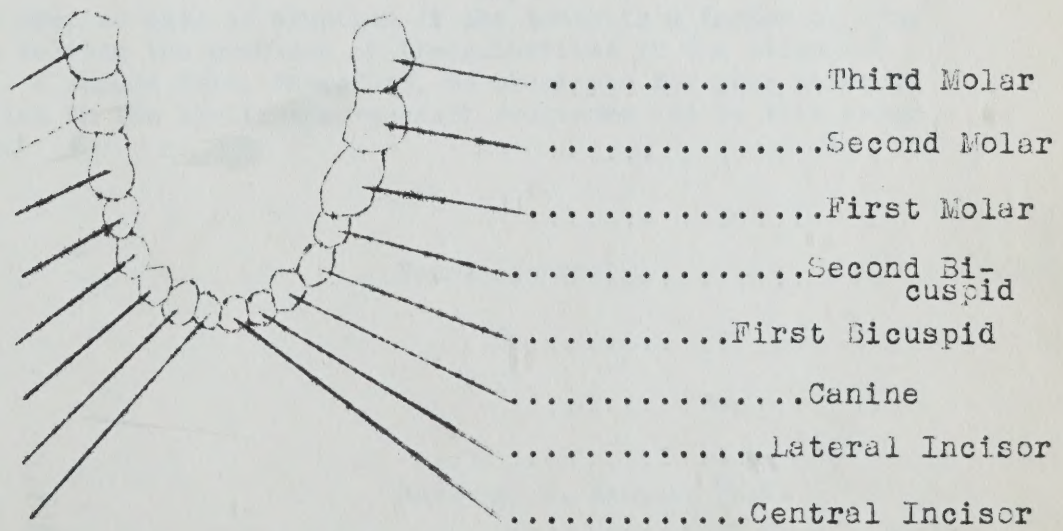
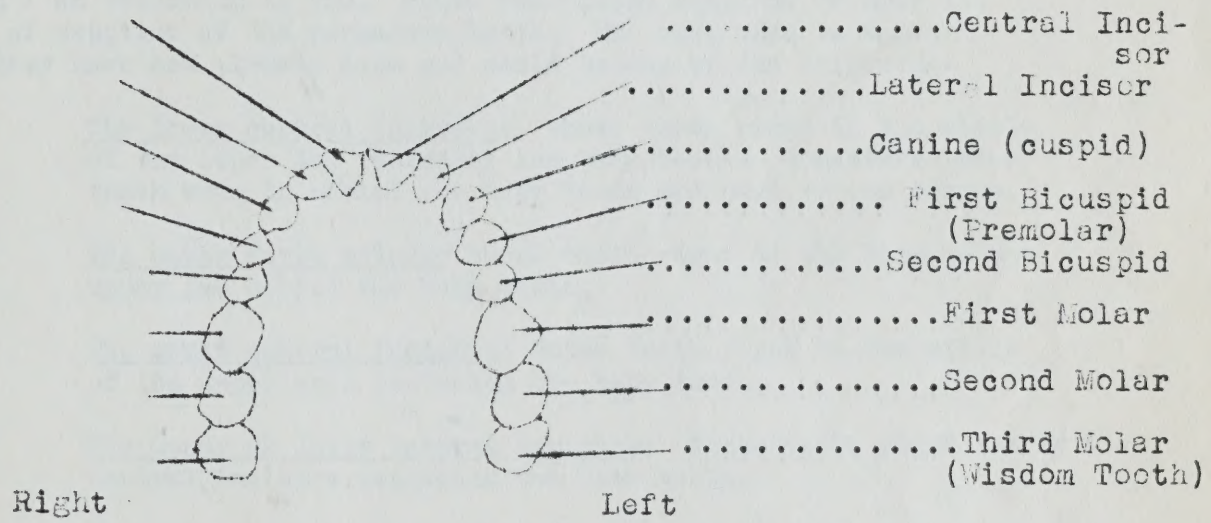
Dates of Eruption of Permanent Dentition.

Name

Dates of Eruption

Dates of Eruption

Maxillary or Upper Jaw



Mandibular or Lower Jaw.

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Orthodontic Research Clinic,
136 Brant Street,
Burlington, Ontario

Dear

Enclosed is the eruptive record form of which I am returning to you. Would you please continue to note the date of eruption of the permanent teeth. The next ones to appear (if they have not already done so) could be any of the following:

The lower central incisors; those teeth right in the middle of the lower jaw replacing the baby teeth. Sometimes these teeth come in behind the baby teeth and next to the tongue.

The upper first molars; those teeth right at the back of the upper jaw behind the baby teeth.

The upper central incisors; those teeth right in the middle of the upper arch replacing the baby teeth.

The upper or lower lateral incisors; those teeth right beside the central incisors replacing the baby teeth.

The precise date of eruption of the teeth is a factor of some importance in solving the problems of irregularities in the alignment of the teeth. I should like, therefore, to thank you for your interest and co-operation in the Burlington research programme and in this study in particular.

Yours sincerely,

Margaret E. Hatton, Ph.D.

Problem

The aim of the study was to determine whether or not tooth size and tooth position at three years of age, together with the rate of upward movement of the teeth between this age and six years bear any relation to clinical eruption by 72 months. Moreover, can growth in arch width be shown to be associated with presence or absence of the teeth in the mouth at 72 months.

Source of Data

The present report includes 50 sets of records. These are of boys only whose age at their first visit was between 35 and 40 months. These children are now six years old and thus have four complete sets of annual records from which models and cephalometric radiograms were available, and to which eruptive records have been added during the last year.

The reliability involved in tracing the oblique cephalometric radiograms for this particular study is the subject of a separate paper; from the models of each child the width of the arch was derived, and the dates of eruption were obtained by sending special record forms to each mother (Fig.2). These forms were sent out only after the problem had been discussed with the parent and each had been informed as to which region of the arch to observe for the teeth.

Observations

Tracings were made of each radiogram and a tangent drawn to the inferior border of the mandible, all observations being restricted to the region of the first molars. The following bilateral measurements were then made (Fig.3):

Molar Height: The perpendicular distance from the mid-point between the two highest cusps of the first permanent molar to the inferior border of the mandible.

Tooth Size: Mesio-distal width of the tooth.

Arch Width: Using the models, the width of the dental arch was measured on the distal margin just posterior to the distal fossae of the second deciduous molars.

Clinical eruptive time: The date when the tooth actually appeared in the mouth was derived from the record forms (Fig.2) and by examining the child.

The data upon which the following analyses are based are shown in Data Files 40, 41, and 42.

Analysis

✓ (1) To determine whether or not tooth size at 36 months of age is related to clinical eruption at 72 months.

For this test only those children whose average age was 36 months at their first visit were included. The mean difference between tooth size in those children with erupted teeth at 72 months and that of children without eruption at this age was tested. Figure 4 illustrates the distribution of this characteristic amongst the two groups of children : $t = 2.798$, so that $P = .01$, a result indicating a significant difference in tooth size of the "erupters" and "non-erupters".

✓ (2) To determine whether or not tooth position affects time of clinical eruption.

For this test only children of 36 and 37 months of age were included, and the height of the tooth above the inferior border of

the mandible was compared in those erupted and those not erupted at 72 months. Figure 5 illustrates the relation of this feature of intra-alveolar eruption in the two groups of children; $t = 1.8852$ and P is nearly .05, bordering on significance. Turning to Data file, Table 40, it will be noted that the position of the teeth varies widely in children of the same age. The present test brought out no significant difference in position between these cases with teeth intra-orally at 72 months and those without teeth intra-orally at this age.

(3) To determine whether or not the rate of upward movement (as estimated between three and six years) is related to eruption at 72 months.

In this test only those individuals of the same age whose teeth were in the same position above the inferior border of the mandible were included. The results which are shown in Figure 6 indicate a marked difference in the rate of upward growth of the teeth in these two groups of children. t is 7.6259, and $P = .001$, a highly significant result.

In consideration of this feature of tooth movement a further comparison was made. From a random group of 60 three year old boys taken from the serial sample, the mean molar height was found to be 17.4 mm.; from a random group of 50 six year olds taken from the control sample the mean molar height was found to be 26.99 mm.. Thus the overall increase between these two different groups of random children is 9.5 mm.. Data file Table 43 shows the comparison between these groups of children. The distance travelled by the random samples and the present one differs only by .54 mm.. But the

teeth of the 23 "erupters" in the present sample of 50 cases have moved 11.16 mm. Moreover, no erupted teeth had travelled less than 9.1 mm..

Since the individuals with erupted teeth at 72 months have been shown to be those whose teeth are moving at a greater rate over the three years than those with no eruption at 72 months, a further test was made to ascertain whether or not this rate could be detected between three and four years. Therefore, the distance travelled between the ages of three and four years was compared with that travelled between three and six years. A scatter diagram (Figure 7) is shown and the product moment was $r = + 0.55$, $P = 0.01$.

(4) The final test was to determine whether or not increase in arch width between three and six years is related to eruption at 72 months. In this test only those children who were 36 months of age were included. The actual increase in arch width between three and six years in the erupted and non-erupted groups at 72 months is shown in Figure 8. " t " = 1.0562, $P = .30$, a result indicating no significant difference in increase in arch width between the erupters and non-erupters.

Summary

A number of observations have been carried out in order to clarify certain features of the teeth in intra-alveolar eruption and any bearing which these might have on clinical eruption. The sample which provided the data included 50 boys between the ages of 35 and 40 months at their first visit. These children are now six years old and thus have four complete sets of annual records. The results obtained show the following:

✓ (1) Between the ages of 36 and 72 months the crown of the lower first six year molars are constantly moving away from the inferior border of the mandible⁸.

✓ (2) Individuals of the same age (within the range 35 - 40 months) may have their teeth anywhere from 14.9 mm. to 19.9 mm. above the inferior border of the mandible.

✓ (3) Tooth size (width) is greater in children without teeth intra-orally at 72 months as compared with children having their teeth at this age.

✓ (4) No significant difference could be found in the position of the teeth at 36 months in the erupters or non-erupters at 72 months.

(5) Rate of eruption varies significantly between the two groups of children; those with teeth at 72 months had an eruptive rate of 10.9 mm. for three years whereas the non-erupters had only 6.7 mm. for three years. These children all had teeth in the same position at 36 months. In the average male between the ages of three and six years the lower first molars have moved a distance of 9.27 mm.

(6) Rate of movement of the teeth between the ages of three and four years is positively correlated with overall rate between three and six years.

(7) No significant difference could be found in the increase in arch width between the ages of three and six years in the early and late erupting groups.

Conclusions

The present problem has involved a study of four characteristics in one stage of the growth and development of the teeth and jaws. It has been shown that clinical eruption is correlated to tooth size,

and the rate of movement of the teeth; and that rate of movement between three and four years of age is indicative of rate of movement between three and six years. Since the lower first permanent molars of the average child travels 9.27 mm. in the three years, from 36 to 72 months, it is possible to estimate when a tooth will be in intra-oral eruption by determining the distance it has moved between three and four years. In the present study of 50 males only five children had teeth which had travelled over 9.1 mm. and had not broken the oral mucosa at 72 months; two of these erupted their teeth at 73 months, and the other three lacked inter-maxillary space having a condition of marked mandibular retrusion, a situation described by Diamond⁹.

In summing up it may be said that the pattern of growth displayed in intra-alveolar eruption is characteristic of the growth process in general and exhibits marked variation in rate of the process between individuals.

In terms of its clinical interpretation, the value of the study lies in the fact that since it is concerned with the effects of one stage of growth and development upon the next successive stage it thereby embraces a prediction factor. The clinical and occlusal stages of eruption are the two with which the clinician is immediately concerned; this study has shown that characteristics of an earlier stage in this process are related to these two later stages. Moreover, other investigators, including Korkhaus ¹⁰, have pointed out that the pre-eruptive stage of eruption is controlled by gene action. The present writer in an earlier work ¹¹ was able to demonstrate that the time taken for a tooth to reach clinical

eruption is governed by hereditary factors. Tooth size ¹² rate of movement of the teeth and tooth position may therefore be said to be controlled by gene function; rate of movement and tooth size influence clinical eruption, therefore clinical eruption is under genetic control. A knowledge of the characteristics controlling intra-oral eruption should assist the practitioner in analysing the needs of a particular case

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DATA FILE TABLE 40

MEAN AND RANGE IN TOOTH POSITION¹ FOR 52 BOYS.

ALSO SHOWN IS THE MEAN FOR "ERUPTERS"² AND "NON-ERUPTERS"³.

AGE IN MONTHS	35	36	37	38	39	40
$\bar{x}$	16.7	17.1	17.5	16.7	17.7	19.3
When N =	1	25	16	3	4	3
Range =		15.4-19.3	14.9-19.9	15.8-17.5	16.4-20.3	16.3-21.3
$\bar{x}$ for Erupters		17.4	18.1	17.5	17.9	20.9
When N =		9	8	1	3	2
$\bar{x}$ for Non-erupters =		16.9	16.8	16.4	17.1	16.3
When N =		16	8	2	1	1

¹ Height (in mm.) of $\overline{6/6}$ above the inferior border of the mandible.

² Erupters = children with teeth intra-orally at 72 months or earlier.

³ Non-erupters = children without teeth intra-orally at 72 months.

DATA FILE CASE 40

MEAN AND RANGE IN EACH POSITION FOR BOYS

ALSO SHOWN IS THE MEAN FOR "FATHERS" AND "MOTHERS"

AGE IN MONTHS	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Mean	10.7	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.7	12.9	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.5
Range	10.0-11.4	10.5-11.7	11.0-12.2	11.5-12.5	12.0-13.0	12.5-13.5	13.0-14.0	13.5-14.5	14.0-15.0	14.5-15.5	15.0-16.0	15.5-16.5	16.0-17.0	16.5-17.5	17.0-18.0	17.5-18.5	18.0-19.0	18.5-19.5	19.0-20.0
Mean N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Mean M	10.7	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.7	12.9	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.5
Mean F	10.7	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.7	12.9	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.5

Notes: (a) N = number of children in each position; (b) M = mean for mothers; (c) F = mean for fathers; (d) Range = difference between highest and lowest scores in each position.

Data File

TABLE 41. POSITION (MM.) OF $\overline{6/6}$ ABOVE THE INFERIOR BORDER OF THE MANDIBLE IN 50 MALES.

CASE #	AGE IN MONTHS AT EACH VISIT				TOOTH POSITION AT EACH OF FOUR VISITS			
	1	2	3	4	1	2	3	4
278	38	53	60	72	15.8	18.1	19.9	24.2
387	37	50	58	72	16.4	17.7	19.2	23.2
152	37	51	60	72	18.5	21.6	24.7	26.1
375	40	48	60	72	16.3	17.4	18.5	20.1
283	36	51	64	72	18.4	22.4	27.3	29.8
133	36	52	60	72	16.9	19.2	20.5	24.4
319	37	52	60	72	17.9	23.3	28.5	29.4
636)	37	50	57	70	16.4	20.2	20.5	27.5
636)	37	50	57	70	16.2	18.9	19.9	25.4
135	37	48	60	72	18.8	20.1	24.0	29.6
117	36	52	60	72	17.3	19.7	21.5	26.0
392	37	50	58	73	17.3	18.1	19.7	24.3
169	36	52	60	72	19.4	21.2	23.1	27.6
478	36	49	59	71	16.4	17.9	19.2	21.2
191	37	52	62	73	14.9	17.4	20.0	24.7
620	36	50	60	73	16.8	18.8	20.4	26.6
612	36	48	60	71	15.4	18.0	19.4	21.7
166	36	53	61	71	18.4	21.2	22.3	25.8
295	36	54	61	71	17.2	21.2	23.6	27.7
357	37	50	58	73	17.5	20.3	22.6	27.3
607	36	50	60	72	17.4	20.2	21.8	24.7
637	36	50	60	72	16.8	20.9	25.9	30.6
896	39	48	60	72	17.5	19.0	22.0	28.1
610	36	49	60	72	16.4	19.0	20.8	26.2
632	35	49	60	72	16.7	16.9	21.6	26.1
609	36	51	61	72	17.8	20.8	24.0	30.3
630	37	58	58	72	18.4	20.9	23.8	30.5
355	36	50	57	70	18.4	21.9	24.8	29.0
398	39	52	60	72	16.4	18.7	20.5	26.3
399	37	51	59	73	18.4	20.3	24.0	29.8
596	37	50	57	70	18.1	20.1	21.3	26.4
635	36	49	60	72	18.5	20.5	24.0	29.3
75	36	52	60	72	15.8	18.3	20.0	25.8
480	36	49	58	71	15.4	18.1	19.9	24.2
543	36	52	58	70	18.2	21.6	23.6	29.9
456	40	52	60	72	20.4	23.4	26.7	31.3
650	39	48	59	71	20.3	23.5	27.6	30.0

Data File

TABLE 41.
(continued)

POSITION (MM.) OF $\overline{6/6}$ ABOVE THE INFERIOR BORDER
OF THE MANDIBLE IN 50 MALES

CASE #	AGE IN MONTHS AT EACH VISIT				TOOTH POSITION AT EACH OF FOUR VISITS			
	1	2	3	4	1	2	3	4
660	38	48	59	71	17.0	18.6	19.6	24.2
291	36	51	59	71	15.8	17.4	18.9	22.5
168	36	51	59	71	18.4	19.2	20.4	21.9
629	37	50	57	70	17.3	18.8	21.9	26.8
529	38	50	58	71	17.5	20.3	22.0	27.8
782	40	51	58	70	21.3	23.4	26.0	31.6
724	37	50	60	72	19.9	22.2	26.4	31.0
605	36	49	60	72	18.2	20.3	23.3	28.2
467	37	50	58	72	18.4	21.5	24.4	29.3
891	39	50	60	72	17.1	18.3	19.1	22.3
623)	36	50	61	72	17.0	28.7	23.6	30.5
623)	36	50	61	72	16.3	18.7	21.4	24.4
578	36	48	58	70	16.3	18.9	20.5	24.4
468	37	44	57	71	16.1	18.2	20.1	23.0
176	36	52	60	72	15.4	17.7	18.6	22.6

Data File Mesio-distal Width*of 6/6 (from oblique cephalograms) and Arch
 Table 42 Width at 3 & 6 yrs.(approx.) of age in 50 Males. Also shown is
 Presence or Absence of 6/6 intra-orally at 6 yrs.

CASE	MES-DIS WIDTH in		ARCH WIDTH in mm.		INTRA*ORAL ERUPTION at 6 years	
	3 yrs.	mm. 6 yrs.	3 yrs.	6 yrs.	Yes	NO
278	12.8	12.6	33.6	35.5		no
387	13.2	13.5	37.6	38.5		no
152	11.6	11.9	37.0	38.9		no
375	12.6	12.7	36.7	36.9		no
283	12.2	12.5	35.7	36.6	yes	
133	11.4	11.8	34.6	34.7		no
319	11.4	11.8	34.0	36.0	yes	
636	12.5	12.7	35.4	36.3	yes right	no left
135	11.1	11.4	34.9	37.6	yes	
117	12.1	12.1	32.4	33.5		no
392	11.7	11.7	34.0	34.9		no
169	13.1	12.9	35.0	36.0		no
478	13.6	13.3	40.0	41.7		no
191	11.4	11.6	32.9	34.9		no
620	10.2	10.4	35.7	37.0	yes	
612	10.6	10.7	35.3	36.0		no
166	13.0	13.0	35.1	37.4		no
295	12.3	12.4	35.4	37.3		no
257	12.6	12.7	33.4	33.5		no
607	12.6	12.6	34.2	36.5		no
637	11.4	11.4	33.7	33.4	yes	
896	12.5	12.5	33.3	34.9	yes	
610	12.3	12.0	35.8	35.7		no
632	12.6	12.6	33.4	35.4		no
609	12.0	12.3	36.9	39.9	yes	
630	11.5	11.9	32.8	35.2	yes	
355	11.1	11.1	32.4	34.2	yes	
398	11.8	12.5	34.3	36.5	yes	
399	12.2	12.3	36.9	37.4	yes	
596	11.3	11.4	35.4	37.4		no
635	12.4	12.1	36.4	38.9	yes	
75	11.9	12.0	35.7	36.0	yes	
480	11.8	12.0	34.8	36.6		no
543	12.0	12.1	34.0	35.5	yes	
456	11.6	12.1	33.6	33.6	yes	
650	11.7	11.4	34.6	37.3	yes	
660	12.1	11.9	37.5	40.0		no
291	11.6	11.8	35.4	35.5		no
168	12.2	12.3	30.4	30.4		no
629	11.7	11.6	32.2	33.9	yes	

* Mean measurement for left and right

Data File Mesio-distal Width* of $\overline{6/6}$ (from oblique cephalograms) and Arch
 Table 42 Width at 3 & 6 yrs. (approx.) of age in 50 Males. Also shown is
 cont. Presence or Absence of $\overline{6/6}$ intra-orally at 6 yrs.

CASE	MES-DIS WIDTH in mm.		ARCH WIDTH in mm.		INTRA-ORAL ERUPTION at 6 yr	
	3 yrs	6 yrs.	3 yrs.	6 yrs.	Yes	No
529	12.1	12.4	33.3	33.7	yes	
782	11.5	11.1	35.7	37.2	yes	
724	11.9	12.3	31.4	32.2	yes	
605	12.1	12.4	34.4	35.8		no
467	13.2	13.0	33.3	35.9	yes	
891	13.0	13.2	37.0	37.4		no
623	13.2	13.1	35.4	35.0	yes right	no left
578	12.5	12.3	36.7	36.7		no
468	11.4	11.6	35.8	36.4		no
176	12.5	12.2	36.4	38.5		no

*Mean measurement for left and right.

DATA FILE TABLE 43

POSITION (m m) OF $\overline{6/6}$ ABOVE THE INFERIOR BORDER OF THE

MANDIBLE IN THREE GROUPS OF MALE CHILDREN AT 3 and 6 YEARS

PRESENT SAMPLE
50 MALES

RANDOM SERIAL SAMPLE x
60 MALES

RANDOM CONTROL[£]
SAMPLE 50 MALES

AGE IN YEARS	3	6	3	6
TOOTH POSITION(mm)	17.18	26.18	17.45	26.99
INCREASE IN 3 YEARS	9.00			9.54
INCREASE FOR ALL ERUPTERS N = 23	11.16			

x 60 cases from the total serial sample taking part in the Orthodontic Research programme at the Clinic.

£ 50 cases from the six year old control sample included in the Clinic's records.

PROJECT (a) is a project to develop a new product line for the company. The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year.

Project Name	Project Manager	Project Status	Project Budget	Project Timeline
Project A	John Doe	On Track	\$100,000	Q1 2024 - Q3 2024
Project B	Jane Smith	Delayed	\$200,000	Q2 2024 - Q4 2024
Project C	Mike Johnson	On Track	\$150,000	Q3 2024 - Q1 2025

The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year. The project is expected to be completed by the end of the year.

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1953-54	-----	-----		23,374.95
1954-55	-----	-----		18,454.00
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1956-57	-----	-----		25,510.00
1957-58	Salaries	\$17,950.00		
	Travel	814.75		
	Equipment	-		
	Supplies	3,325.00		
	Rent &			
	Utilities	2,550.00		
	Other	1,050.00		
		<u>\$25,719.75</u>		<u>25,719.75</u>
			\$	<u>128,760.70</u>

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